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[OFFICIAL NOTICE.]

Thirty-fifth Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
EAST BOSTON, MASS., Feb. 1, 1905.

To the Members of the New England Association of Gas Engineers: The Thirty-fifth annual meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, Wednesday and Thursday, February 15th and 16th, 1905.

Papers and topics will be presented on the following subjects:

"Some Practical Record Sheets;" by Mr. W. L. Walker, Fitchburg, Mass.

"Gas Mantles and Gas Mantle Lamps from a Commercial Standpoint;" by Mr. W. R. Addicks, New York.

"Accidents to Gasholders and Tanks;" by Mr. C. H. Corbett, Brooklyn, N. Y.

"The Relations of Firebrick Material to Retort House Construction;" by Mr. H. A. Carpenter, Pittsburg, Pa.

"Ammonia;" by Mr. D. D. Barnum, Worcester, Mass.

"Working with Deep Purifiers;" by Mr. C. H. Gifford, New Bedford, Mass.

"The Tar Situation;" by (?).

QUESTION BOX.

"Should gas companies favor setting all prepay meters to the exclusion of plain meters?"

"How can naphthaline be prevented from forming?"

"How can it be disposed of in street mains?"

"How are the mechanical devices for handling coal, hot coke, oxide, ashes, etc., working?"

"Can we co-operate in the sale of our tar?"

"How can the house governor nuisance be controlled?"

Members are urged to send in any other questions they wish discussed, that they may be assigned to someone for answer. The annual banquet will be served Wednesday evening. Application blanks for membership may be had of the Secretary. The Proceedings of the Association, for the years 1897 to 1903 inclusive, are now in print and duplicate copies are for sale. Large additions have been made to the Library, in Room 715, Tremont Temple, and members are urged to visit the room and see how they may avail themselves of its privileges.

All friends of the Association are cordially invited to attend the meeting, whether receiving a formal invitation or not.

N. W. GIFFORD, Secretary.

[OFFICIAL NOTICE.]

Respecting the Official Work of the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
SECRETARY'S OFFICE,
530 Broadway, N. Y., Dec. 13, 1904.

To the Members American Gas Light Association: As there seems to be some misunderstanding respecting the standing of the official management of the Association, members will please note that the undersigned is the Secretary of the Association, and that Mr. A. E. Forstall is carrying forward the work of the Practical Class. All correspondence in connection with the Practical Class should therefore be addressed to Mr. A. E. Forstall, 58 William street, and all other matters pertaining to the Association to MR. GEORGE G. RAMSDELL, Secretary, at the above address.

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[OFFICIAL NOTICE.]

Wrinkle Department, Ohio Gas Light Association.

OHIO GAS LIGHT ASSOCIATION,
OFFICE OF SECRETARY,
DELAWARE, O., Nov. 21, 1904.

The Editor of the Wrinkle Department, Mr. E. E. Eysenbach, General Manager of the Binghamton (N. Y.) Gas Company, earnestly solicits the co-operation of the fraternity for contributions to be presented to the Twenty-first Annual Meeting of the Association, which is to be held at the Hotel Schenley, Pittsburg, Pa., March 15th, 16th and 17th, 1905.

Editor Eysenbach will be pleased to receive contributions not later than February 10th. Work for the good of the cause and send him your "Wrinkles." T. C. JONES, Secretary.

[OFFICIAL NOTICE.]

Novelty Advertising and New Business Methods Department, Ohio Gas Light Association.

SECRETARY'S OFFICE,
DELAWARE, O., January 16, 1905.

The Editor of the Novelty Advertising and New Business Methods Department, Mr. B. W. Perkins, of South Bend, Ind., desires to announce that his department is now open for contributions to be presented at the Twenty-first Annual Meeting, which is to be held at the Hotel Schenley, Pittsburg, Pa., March 15th, 16th and 17th, 1905.

The sale of gas is one of the most important branches of our industry and this department is one of the most attractive features of the convention. It is, therefore, earnestly hoped that the fraternity will heartily co-operate with Mr. Perkins, and send him advertising and new business method schemes. T. C. JONES, Secretary.

[OFFICIAL NOTICE.]

Bureau of Information, Ohio Gas Light Association.

CITY OF LINCOLN GAS CO.,
LINCOLN, ILLS., Oct. 10, 1904.

To the Fraternity: At the last meeting of the Ohio Gas Light Association a Bureau of Information was decided upon, the idea of which is to render assistance to members who may have questions coming up or difficulties arising respecting which they would like some help. This Bureau has been established and is now ready for business. A number of co-Editors have been appointed to whom the various questions will be referred. As this is the first Bureau of Information attempted by any Association, it is hoped that the members will take advantage of its opportunities. The co-Editors are as follows:

Distribution.—E. E. Eysenbach and M. E. Malone.
Accounts and Bookkeeping.—D. W. Low and Chas. Ritter.
New Business and Gas Appliances.—Frank D. Moses, Ralph Woodward and F. Cavanagh.
Chemistry—H. B. Harrop and Clarence Lomax.
Retort House.—Moses Coombs.
Natural Gas.—W. H. Hammon and Geo. W. Barnes.

All questions should be addressed to the Editor, at Lincoln, Ills.

Very truly yours,
H. L. OLDS, Editor Information Bureau.

BRIEFLY TOLD.

THE NEW ENGLAND'S THIRTY-FIFTH ANNUAL MEETING.—In our current issue is printed the official announcement, by Secretary Gifford, of the stated proceeding for the Thirty-fifth annual meeting of the New England Association of Gas Engineers. The sessions will be held in Young's Hotel, Boston, Wednesday and Thursday of next week, and the meeting place will also be headquarters. The convention will, of course, be under the able direction of President Frank S. Richardson, of North Adams, Mass., whose training, both as a gas man and an officer, insures able governing of a body that is always tractable. Secretary Gifford's programme, of that which is to be done in a technical sense at the meeting, well proves that the New Englanders are abreast of the work that causes their trading to grow; and at least two papers on the list are sure to bring out spirited discussion. As near as we may figure it the sentiment of the New England Association is against the amalagation theory, although it is certain the Association will gladly and effectively work with other kindred bodies for the advancement of the profession. The attendance is sure to be large, even though severe weather conditions are prevailing.

NOTES——

AT the meeting of the Trustees of the Consolidated Gas Company, of this city, held for the purpose of perfecting the executive management of the Company, Mr. H. E. Gawtry declined a re-election to the Presidency. The declination was based on his continued illness. No President was named. The other officers were re-elected, as of the past year.

AT the annual meeting of the Lebanon (Pa.) Gas Company the following Directors were elected: L. E. Weimer, John W. Mish, H. C. Grittinger, Chas. H. Hillinger, J. P. S. Gobin and Grant Weidman. Subsequently the Directors named the following executive management: President, L. E. Weimer; Vice-President, H. C. Grittinger; Secretary and Treasurer, John W. Mish; Superintendent, W. H. Merritt. Mr. Mish has acted as Secretary and Treasurer of the Company since its organization in 1857. A semi-annual dividend of 4 per cent. was declared.

The Trend of Gas Invention.[1]

An article which had appeared in the AMERICAN GAS LIGHT JOURNAL on "The Profession of Gas Engineering in America" received a fortnight since a little [belittling] editorial examination in these columns. The author of the article in our contemporary made a somewhat scathing criticism of the indigency of the creative faculty in the gas profession of America, as disclosed by the records of the past; and we were, and still are, inclined to think that the assertions were not particularly helpful to the main purpose (which constituted a rather startling proposition in these progressive days) of his article. However that may be, in making our annual investigation of the gas specifications issued by the Patent Office of this country during the past year, we have certainly been struck by the paucity of the gas inventions for which our American cousins have applied for protection in this country. Prominence is given to this statement in the hope that the last has not been heard of the article to which reference is made, and that the question will be discussed, and their position defended, by our American friends.

Meanwhile it is pleasant to note that, so far as this country and the Continent are concerned, there is no retrogression, as revealed by the patent specifications, in the matter of gas invention. The total number of abstracts of gas specifications which were published in the *Journal* during the past year was 298, of which this country takes credit, with a few from the Colonies, for 162, and the Continent, with a few from America, for 136. This number of 298 is only a dozen less than the total for 1903, and compares with 240 for 1902, and 259 for 1901. The slight falling off from the 310 abstracts published in 1903 is more than accounted for by the fact that many specifications were rejected during the year as being unworthy of notice, and from which it was believed no useful result would accrue in according them publicity in our pages. "Invention" is a term to which (according to many specifications of patents) a very strained interpretation is frequently applied; and, consequently, many specifications come to hand, the puerility of the subject of which borders on, if it does not actually overstep the border of the humorous. Such as these can only be placed on one side with a passing pitying thought for the men who imagine they have enriched the world, and have found the pathway to their own financial improvement; while as a matter of fact their so-called "patent rights" are not worth the paper that their specification was originally written upon. We permit ourselves this little latitude in the criticism of the gas "patents" which have been left unnoticed during the past year in the belief that, dealing with the essential parts of such numbers of specifications each year—numbering, for example, as the figures already mentioned show, upwards of a thousand in 4 years only—enables a fair discrimination to be made between those subjects for which protection has been sought that contain at least ingenuity and those that are of negative value.

However, the scrutiny of the year's gas specification publication has shown that, not only in number but in quality, there has of late been no decline; and it is very apparent that activity in every department in which attention is for the time being turned is general in this country and on the Continent. Whether we look to the specifications dealing with the plant engaged in the carbonizing operations of a gas works, purification, distribution, or the appliances through which consumption takes place, this is so. In the total of our abstracts last year, this country boasted only 26 more patents than came to us from abroad. In the carbonizing department however, we cannot take credit for any great superiority, excepting in certain directions; and in the course of this article, an endeavor will be made to show in what particulars thought, experiment and invention have been at work. It is remarked, however, that in the inventions which come to us from the Continent, the sources from which they emerge are very restricted, which is no doubt a result of the retention in comparatively few hands of Continental retort house structural work. But the balance in numbers with this country in new inventions in connection with gas manufacturing systems is only obtained by the greater enthusiasm shown abroad for gas producers of various types. In the purification department—in plant and processes—this country shows a slight advantage; and the same may be said in residual products work. Beyond the gas works, and in appliances for the utilization of gas in various ways, there is a continued augmentation of attention by inventors at home; and this is especially the case in the production of incandescent light fittings and even of mantles. As to whether the "improvements" have generally any real value, we will not pronounce an opinion on the insecure basis (for judgment) of patent specifications; but the fact

1. *Journal of Gas Lighting, Water Supply, etc.*

remains that, since the incandescent mantle market of this country has been thrown open, sterility has been displaced by fecundity through the constantly broadening interest of those of inventive propensity in all that appertains to the incandescent gas system.

Commencing our rather more minute survey of the inventions of which knowledge was obtained through the publication of the specifications during the year, it is interesting to observe that, getting right back to the root of gas manufacturing work, the furnaces of retort settings and the construction of the beds generally still have an attractive influence; and it is of importance that, while methods and processes having for their object the cheapening of retort house labor now appear to be receiving the unremitting thought of many men, the economics of the process of carbonization itself should not be ignored. We cannot have attained finality within the settings themselves. Therefore it is noted with pleasure that to proposals associated with the construction of retort furnaces and beds, at least nine contributions were made during the year, five of which came from abroad. Three of these specifications referred particularly to the inclined retort system, which is evidence that the view of many men is not shared by all, that the new types of stoking machinery for horizontal retorts have settled once and for all the prospects of the inclined system becoming universally regarded as the most economical system of carbonization. The step from the inclined to the vertical retort is a great one, but not so great as from the horizontal to the vertical; and there is no doubt that to the inclined system of working is largely due the revival of interest that has been evinced in the vertical setting of retorts both in this country and on the Continent. We had expected that, long before this, America would have done something towards elucidating the question whether or not the system possesess any merits superior to those possessed by other carbonizing systems; but nothing has, so far as our knowledge goes, been done there in this direction. Our specifications for last year, show that three new proposals connected with this form of retort were made by engineers in this country; and an equal number came from abroad. But it is singular, and savors somewhat of skepticism, that so few men should be working on these lines, seeing that the results so far are promising of success being eventually achieved. If the promise is not fulfilled, there will be great disappointment. Further than saying this, no one can at present go. It is also worthy of remark that, while inclined retorts have an arch antagonist in London, the same gentleman is responsible for a vertical retort with a horizontal clearing chamber below, making the arrangement look something like an inverted **T**. But because he has patented this retort and system of discharge, it cannot be assumed that it betokens any partiality for the system. While on vertical retorts it may also be noted that some of the new ideas for gas producers which have come before us during the year include examples containing a central vertical retort; the intention being to utilize the heat of the producer in carbonizing charges in the central retort, for the making of two kinds of gas—for instance, gas for heating in the producer and lighting gas in the vertical retort. Another patent to be noted here is one from abroad which has for its object the strengthening of vertical or horizontal retorts. This little digression has taken us from the continuity of line which we had struck for dealing with the specifications; and for the moment return must be made to the horizontal and inclined retort settings, in order to show that their fittings have not escaped further consideration. There were six suggestions placed to the credit of this country in this respect during the year; but not one was imported. There is a new proposal for feeding the water on to the furnace bars of retort furnaces, one connected with retort lids, and a third is designed to prevent the choking of ascension pipes; while the feeding of inclined retorts has attracted one inventor, and two others have been devoting themselves to making improvements in the stops and mouthpieces of the same form of retorts. The hydraulic main, too, has received the further notice of one English inventor and of one abroad. Even the repairing of retorts has not been lost sight of, with the result that we have a new retort cement and a form of pulverulent material for coating and joining retorts.

In regard to other gas manufacturing systems, we must revert to the exploration and exploitation of gas generators and producers, which which go merrily on. But it would appear to be indicative of a greater belief in them abroad than in this country when it is observed that, against thirteen specifications for them of foreign origin, we can only oppose five. Some of these are particularly devised for gas engine use, the suction type is represented, the dual system of producing gas already referred to finds place among them, while others contemplate the production of poor gas free from tarry matters. Not far removed from these systems, we have an invention of certain fuel compounds for use in generating gas; and there is another form of the hoary fancy for making gas from wood. In this particular group, we have a couple of specially novel features. The mind is carried back to what is recorded of the early days of gas manufacture, when gas was distributed in cylindrical vessels from door to door. Here we have a suggestion for the reduction of gas by compressors to a liquid state, and, after being cooled, drawn off into suitably formed bottles for distribution. The second novelty is Pearson's system of what has, for simplicity, been described as the chalk gas process, though it is long since notice was first taken of it in the press. Mr. Pearson would be quite a benefactor to mankind if he could satisfactorily prove that our vast chalk deposits could be economically utilized to assist in conserving the wealth of coal upon which our country mainly depends for its prosperity. It may be taken as an illustrative of the trend of events in this country—the dropping to a lower standard of illuminating value for gas, in view of the incandescent mantle and the large heating uses of gas—to notice that there are only two oil gas introductions from abroad, and none home produced; and only two native enriching processes, with two foreign air and gas carburetters.

While speaking of producers, water gas apparatus should have been mentioned; but these are worth an independent note, even though there were no particularly striking innovations. It, however, but rather induces the feeling that there is little interest taken in this country in the development of improvements in this system of manufacture to find that there were only two proposals in this line for which patents were taken out by British inventors, as compared with half-a-dozen sent from abroad. Two of the arrangements propose the combined production of water and coal gas; while a third contemplates the use of small and dust coal.

This exhausts the plant and processes which have special reference to the production of gas; but we must again return to the retort house in order to note with satisfaction that the improvement of the methods of charging and discharging horizontal retorts still have a superior fascination for those of a mechanical bent of mind. This is only natural, following upon the surprising success that attended the advent of the coal projector in the old-world city of Bruges; and thus we have registered among our specifications abstracts of no less than six inventions from British sources connected with the operation of charging (not counting a new form of machine scoop), and half that number hailed from abroad. The discharging of gas retorts has also claimed a fair amount of study, with the result that we have had five fresh conceptions to put under notice, three of which have crossed the water. Conveying hot coke still brings forward the specialists in this line of plant; but it does not pass observation that along this path of improvement inventors abroad do not appear to be able to raise much enthusiasm—for of five specifications, only one found birth outside this country. In America, as well as in this country, the utilization of the bucket form of conveyor for gas works purposes is courting more attention; and we should not be astonished to find it receiving a greater amount of adoption than heretofore. Among the systems of conveying, perhaps the most unique was that which emanated from Ilford, and proposes the transmission of coke by compressed air or jets of steam, so as to "dispense with mechanical conveying and its attendant disadvantages."

It has been before remarked in these annual surveys of the patent specifications that other parts of the plant of a gas works have not been honored with much attention, and if it were not for the spurt in interest that curiously has been made just at the present time in purification plant, the field of invention within gas works walls, but outside the retort house, would have been barren indeed. Sufficient interest was found in it for notice to be made of a newly patented form of rotary blower or pump, which, however, was an exotic; and only one addition was made from London to the methods of condensing and cooling gases. This brings us to the new proposals connected with purification; and here we have an assortment of ideas for the betterment of plant, processes and product, to the aggregate of 15, 9 of which are of British origin. There is no necessity to specify all the subjects; but among the more notable appear the specifications of the grids known as the "Jager," and those with which the name of Mr. Marshall is identified. Then we have a British proposal for economizing the space and weight of the connecting pipes of purifiers, a couple of descriptions of purifier valves, and a fresh idea for travelling cranes for removing the lids of purifiers. A little out of operating sequence, it may be mentioned that tower scrubbers have one British representative, and washers two from abroad, and one of home production. Other specifications deal variously with means for the extraction of suspended and tarry matters, sulphuretted hydrogen, carbon disulphide and naphthaline. The record in this department is not by any means an unsatisfactory one. Then we have an extremist—not of this country—who has a little thing for

arresting any impurity which may escape past the consumers' meters.

Before leaving the gas works, as the remaining gas plant is not represented (excepting perhaps one station meter by a foreign inventor) by improving notions, we may break off to remark that the plant and methods involved in the treatment of residuals appear to be receiving increased consideration on this side; in one or two years, it may be remembered, it did not take a very prominent place in this line of invention. Last year, however—it may be purely accidental—the British specifications in this regard outnumbered those from abroad, this country showing 8 against 5. Among the home productions, there is a proposal for treating gas liquor, and there is also a new ammonia still. Tar has claimed additional notice, having on its own account no less than 4 specifications, 7 of which are natives. There is one for the elimination of water from tar, another for separating the phenols of coal tar from the neutral constituents, while a third describes how to solidify tar for transport. The distillation of tar is dealt with in a patent from abroad. In other processes referring to residuals, including cyanide recovery, there are 3 foreign specifications and one British. Interest in the question of cyanide recovery does not appear to spread very extensively in this country, no doubt principally for the reason that too great an interest would make the process profitless. Sulphate of ammonia has received attention in a couple of specifications—one British and one foreign. Still on residuals, we find a proposal for treating coke, in order to fix any arsenic there may be in the ash of the fuel when it is burnt. Then there is the idea for constituting the spent lime and clinker of gas works a profitable "residual," by making from these waste materials bricks and other moulded articles. The success of the trial work in this direction is well known.

In the gas distribution department there is not much to notice. In governors there is only one British specification, which is not exactly counterbalanced by a gas pressure regulator. Connected with canalization, there are new, or supposed to be new, ideas to the number of 6 English and 5 foreign. There is a variety of expedients for facilitating the work of making connections, which cannot all be individually mentioned—notably, apparatus for tapping and drilling mains under pressure, new unions, joints, and so forth. A method of strengthening pipes, one referring to pipes and conduits specially constructed for positions where electrical or corrosive action is likely to occur, and another for localizing leakages in underground pipes, are among the things that the inventors are hoping will benefit mankind in general and gas suppliers in particular. Passing from the distribution system, we come to a few new suggestions in meters; but except in the prepayment class, the showing is not imposing. This country and one other only save themselves by one representative each in wet meters. There is nothing in ordinary drys of which to take note. There is one proportional meter from America. In the prepayment line, there are 7 new arrangements, all of home growth. It is rather singular that improvement in the construction of prepayment meters abroad does not seem to make any marked way, unless the absence of patents from abroad in this respect denotes that what improvements are made in other countries are not considered of sufficient importance to protect here. But that can hardly be. Attention is, the records of the year show, also being directed to counting and registering attachments for meters.

Only a few years ago, we remember that this country hung far behind the Continent in patentable ideas in connection with incandescent gas lighting. But times have changed, and now in every department—excepting in the means for automatically igniting and extinguishing gas or in self-igniting burners—this country is keeping neck to neck in the race. Altogether, in the lighting department 114 patents were noticed during the year, 56 of which stand to our own credit, while countries abroad can only show an excess upon this number of 2. Owing to the quantity, we must be excused from making any particular allusion to the inventions, save to point out the lines in which improvement was principally sought to be effected, or special novelty. Incandescent burners took the lead in point of number; and this country, strange to say, was well ahead with ideas aiming for improvement. Inverted burners made a good showing with 15 specifications, 7 of which originated at home. Great aspiration is disclosed in increasing the illuminating value of incandescent lights without having recourse to higher pressures, there being little short of a dozen proposals in this direction. The admission of oxygen to the lighting mixture at the point of combustion is a method that is the subject of 2 patents; but there is doubt on the point of whether the additional candles are quite worth the cost—in other words, whether the additional illuminating value cannot be obtained by cheaper methods. Another idea, which is not new, is the use of a small mantle inside a larger one, so as to form an annular space for the flame, and thus obtain light from two mantles with only one flame. The value of this is also questionable, and there must be a difficulty in maintaining mantles in a perfectly cylindrical and parallel state. Special precautions, too, we can imagine, would be necessitated in the manufacture of mantles destined for this purpose, so that at present we are not favorably impressed with this particular idea. Methods for mixing gas and air were covered by 8 patents, 7 of which were imported, and 5 of them bore the name of "Selas." Mantle making invited the attention of several inventors; but there is not the excitement in this branch that was seen but a few years since. There were 5 proposals in this country and 3 from abroad, one of the latter being the D'Heureuse method of fabric weaving which has been acquired by the Welsbach Company. One patentee has proposed a new material for the manufacture of incandescing bodies, and Baron Auer von Welsbach is seen to have been further investigating the subject of the manufacture of metallic alloys having pyrophoric action and their application to the purposes of ignition and illumination. Means for regulating the gas and air supply to burners are shadowed out in 4 specifications—2 British and 2 foreign. But anti-vibrators and bye-pass taps only boast 2 newcomers. There are several little ideas, one or two showing novelty, for supporting and protecting mantles, and incandescent light fittings have also had additions made to their already large range. High candle power lamps and street lamps have not been very productive classes, but they have not been altogether neglected. We must, as already indicated, take a back seat in the matter of lighting and extinguishing burners from a distance or at stated times, as also in self-igniters. Our friends abroad seem to have a particular liking for devices of this kind, having in the year placed to their account 11 new proposals against our own modest 3. Without doubt, the greatest novelty of the year connected with burners is the one which is capable of burning under water and other liquids, and which was the center of much public attraction at the recent International Gas Exhibition.

The effort to improve gas stoves and fires has been going on apace in this country, and during the year we have recorded no less than 18 inventions of British birth—it is true, of the extremes of merit—as against only one (referring to a burner) from abroad. Burners of various descriptions bulk largely, and there is one convenient arrangement which counteracts the propensity of the domestic servant for wasting gas by leaving boiling rings alight when not in use. In this case there is a bye-pass jet, and the placing of the vessel over the boiling ring opens the gas-way and the gas is ignited. The removal of the vessel shuts off the gas and causes it to be extinguished, leaving only the bye-pass jet alight. The greatest convenience that has been introduced in recent times has been the conjunction of a circulating system of hot water supply, or water heaters, with gas cooking ranges. and examples were described during the year. A small arrangement proposes the regulation of the supply of gas to water boilers, and there is described a convertible gas cooker and heater. Boiling and grilling arrangements have a place in the list, and gas fires—one being of the condensing type—have had fresh contributions.

An exceilent sign is the activity in gas engine invention. We have taken credit in the past year for no less than eleven (including one from New Zealand) improvements in this direction, as compared with eight from the Continent. But there is no doubt about the increasing tendency of gas engine makers to make provision for the attachment of gas producing plant to their engines.

Only one point more, and this has reference to the testing of gas. Testing has not been a prolific field. But one proposal of special interest is Mr. Sugg's revolving arrangement bearing burners for varying qualities of gas; so that testing can proceed, no matter what quality of gas is for the time being supplied, without changing burners. Another home proposal is an apparatus for testing the value and quality of gas; while one is an introduction from abroad for determining the heating value of gaseous and liquid fuels.

This general view of last year's gas patent specifications (which through the force of circumstances have to be served up to our readers, as it were, piecemeal and indiscriminately week by week) will assist readers to fairly judge the course of recent thought and endeavor at improvement in gas manufacture and utilization. It is clear that the most pronounced attention is being devoted to the retort house operations, together with constant but restricted prosecution of work with the object of perfecting vertical retorts. Producers are also having a noteworthy innings. Purification is not by any means a neglected branch; and, notwithstanding the widespread adoption of prepayment gas meters, workers apparently still find plenty of room for improvement. Flat flame burners have entirely fallen before incandescent burners, which, with the mantles and accessories, afford a remarkable

field for the exercise of inventive genius. Gas engines are a good subject; and, as just seen, the details of gas fires and cookers have not escaped notice.

[Prepared for the JOURNAL.]

An Analysis of Concrete-Steel Construction.

By MR. F. C. SLADE, M.E.

Much has been written concerning, and many remarkable structures have been built of concrete-steel. The work naturally resolves itself into several recognized systems, all of which have their peculiar fields of work, and are correct. But a certain amount of mystery and no little wonder have become associated with this form of construction, so that an ill-defined feeling has developed which recognizes the correctness and propriety of remarkable construction in this line, but prefers that someone else should take the responsibility. It is the purpose of the writer to develop an analysis for the design of concrete-steel structures and to so put the matter in shape that it can be readily understood by the ordinary layman. There is no question but that, with the element of mystery removed, gas men generally would gladly adopt this form of construction in many lines of work. The electric companies that were quick to take up the work are enjoying its benefits in many ways throughout the country.

When it is considered that concrete-steel construction is something like 30 per cent. cheaper than masonry or steel work, the attention of gas engineers should be directed to it. The field for this work includes the erection of buildings, roofs, floors, purifier boxes, chimneys and tanks of every description, even to gasholder tanks. Considerable doubt has existed as to the possibility of making concrete-steel tanks water-tight, but practice has shown it is not a difficult matter to make them both water-tight and gas-tight.

Below is given an analysis showing the steps taken to derive a formula, so simple and accurate that it can be readily followed by anybody, for if the reader will take the trouble to follow the description, the accuracy of the formula will be readily appreciated. Once understanding it, if a little trouble is taken to check it against structures in course of erection at different places, confidence will be acquired, and it is hoped that a welcome reception to this form of construction will result.

We will start with a cross section of a concrete-steel beam, shown in Fig. 1. The steel is placed near the tension side of the beam, as shown.

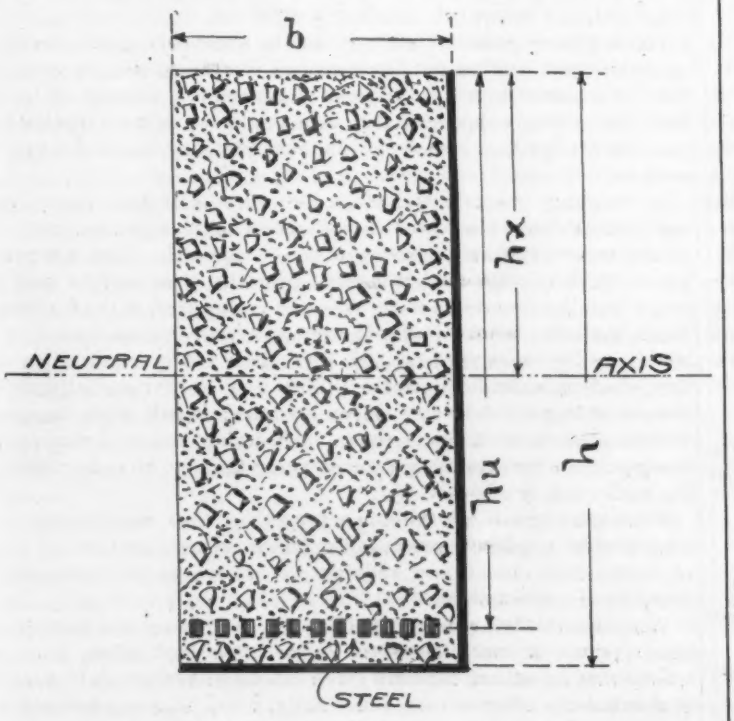


FIG. I.

It is assumed that the beam is safe against shear, and if loaded to failure will break by flexure at the center of the span. We will let (hu) represent the distance from the compression side of the beam to the steel; h is the depth of the beam, and u is a per cent. of h assumed constant and equal to .97; (b) is the breadth of the beam; (x) is a per cent. of (h) so (hx) is the distance from the compression face to the neutral axis; (p) equals the per cent. of steel in the section; (pbh) is the number of square inches of steel in the section when (b) and (h) are given in inches.

Referring, now, to Fig. 2. Let us assume the beam to be deflected

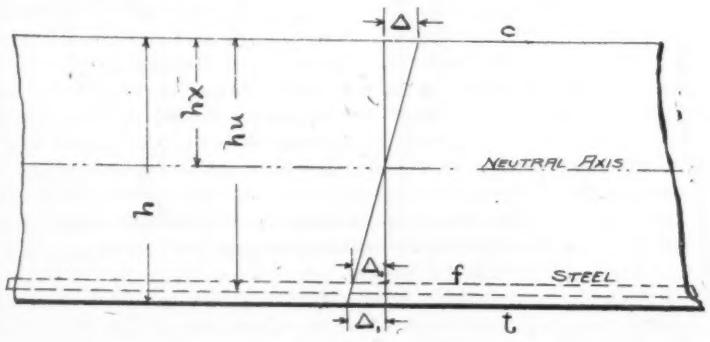


FIG. II.

by a load, and that any plain cross section before flexure remains a plane during flexure. The flexure will cause extension of beam fibers on one side of the neutral axis and compression of the fibers on the other. If the amounts of these extreme outside distortions be represented by

$\triangle_1$ on the compression face;
$\triangle_1$ on the tension face;
$\triangle_{11}$ in the steel bars.

From the relation between the distortions and their distances from the neutral axis, we have the following ratios:

$$\frac{\triangle_1}{\triangle} = \frac{h - hx}{hx} = \frac{1 - x}{x}$$

$$\frac{\triangle_{11}}{\triangle_1} = \frac{hu - hx}{h - hx} = \frac{u - x}{1 - x}$$

The several modulii of elasticity are:

Ec = concrete in compression.
Et = concrete in tension.
Es = steel in tension.

Now $$Ec = \frac{c}{\triangle} \text{ and } Et = \frac{t}{\triangle_1} \quad Es = \frac{f}{\triangle_{11}}$$

If Fig 3 represents the diagram of moments about the neutral

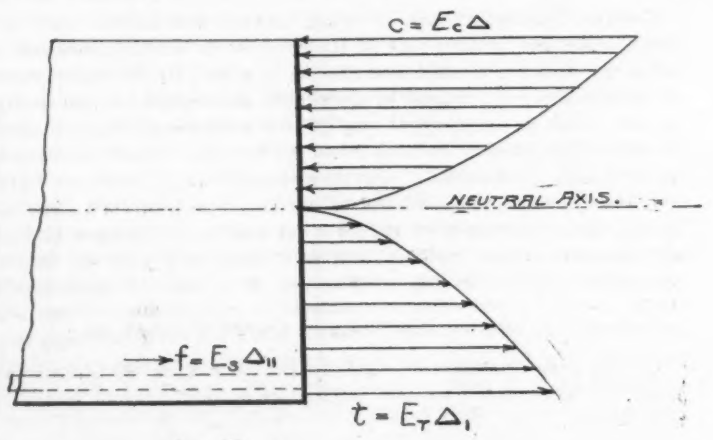


FIG. III.

axis, being the summation of: Forces, multiplied by distance from neutral axis, we have—

$$(a)\ \frac{2}{3} Ec \triangle h^2 x^2 = \frac{2}{3} Et \triangle_1 (h - hx)^2 + ph\,(hu - hx)\,Es\triangle_{11}$$

$$\text{Then: } \frac{2}{3} Ec \triangle x^2 = \frac{2}{3} Et \triangle_1 (1 - x)^2 \times p\,(u - x)\,Es\,\triangle_{11}$$

Dividing the last equation by Et, we have—

$$\frac{2}{3} \frac{Ec \triangle}{Et \triangle_1} x^2 = \frac{2}{3} 1 - x)^2 \times p\,(u - x)\,\frac{Es\triangle_{11}}{Et\triangle_1}$$

Let $\frac{Ec}{Et} = n$, assumed = 2, a constant inside the safe limit of strain.

$\frac{Es}{Et} = m$, assumed = 12, inside the safe limit of strain.

Thus we have: $\frac{2}{3} n x^2 \frac{\triangle}{\triangle_1} = \frac{2}{3}(1-x)^2 + p(u-x)^2 m$

Now $\frac{\triangle}{\triangle_1} = \frac{x}{1-x}$ and $\frac{\triangle_{11}}{\triangle_1} = \frac{u-x}{1-x}$

Substituting $\frac{2}{3} n x^3 = \frac{2}{3}(1-x)^3 + p(u-x)^2 m$

Or, I., $p = \frac{2}{3}\left[\frac{n x^3 - (1-x)^3}{(u-x)^2 m}\right]$

Now, if

c = the maximum compression in outermost fibers;
t = the maximum tension in outermost fibers;
f = fiber stress in steel.

We have from (a)

(b) $\frac{2}{3} ch^2 \times {}^2b = \frac{2}{3}(h - hx)^2 bt + pbh^2 (u-x) f$

b the breadth of beam.

If no tension is allowed in concrete

(b)= becomes $\frac{2}{3} ch^2 \times {}^2b = pbh^2 f (u-x)$

Or, II., $c = \frac{\frac{3}{2} pf (u-x)}{x^2}$

Since the sum of the moments about the neutral axis is equal to the bending moment (M) of the beam, we have from (b) assuming zero tension in concrete:

$M = \left[\frac{2}{3} c \times {}^2 + pf(u-x)\right] bh^2$

(bh^2) being a common factor, we have:

$\frac{M}{bh^2} = \frac{2}{3} c \times {}^2 + pf(u-x)$

But when tension in concrete is assumed to be zero:

$\frac{2}{3} c \times {}^2 (bh^2) = pf(u-x) bh^2$

Also, $\frac{2}{3} c \times {}^2 = pf(u-x)$

So, III., $\frac{M}{bh^2} = 2 pf(u-x)$

Careful distinction must be made between the neutral axis of the beam when the tension face of the concrete is actually cracked, and when its strength is only assumed to be zero. In the latter case the neutral axis is not changed by the simple assumption of zero strength, so care must be exercised to use (x), the distance of the neutral axis from the compression face, as given by formula I., and not assume a value for (c) in formula II., and then solve for (x).

If, now, we assume a series of values for (x) in formula I., and solve for (p), then the respective values of (p) and (x) in formula II., using any assumed value for (f) within safe limit, will give (c) for these variables. The same respective values of (x) and (p) with assumed values of (f) in formula III., will give a series of values for $\frac{M}{bh^2}$

On the basis of standards used by the New York Building Department, we have: c 500 pounds per square in; t 0; f 16,000 pounds per square inch.

On the basis of these values we have—

$\frac{M}{bh^2} = 140$, c=500 pounds square inch, p=.0088 per cent.

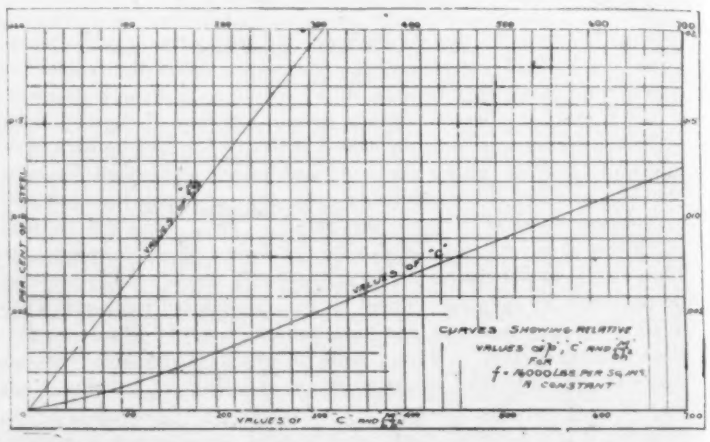
These values are constant for any concrete-steel beam using the above maximum fiber stresses.

If the logic of the above analysis is once understood the formula $\frac{M}{bh^2} = 140$ is all that need be remembered to design a beam for any purpose whatever. For example: If it is desired to design covering for a roof in which the trusses are, say, 6 feet apart, and which should withstand a load of 250 pounds per square foot, we would proceed as follows:

Assume a strip 1-foot wide, and the load on this strip between trusses will be 1,500 pounds, uniformly distributed, the bending moment, M is equal to $\frac{WL}{8}$ L being the length of beam in inches; so M = 13,500.

$\frac{M}{bh^2} = \frac{13,500}{12h^2} = 140.$

So $h^2 = \frac{1,125}{140}$ or h the depth of the beam 2.83 inches.



The amount of steel required can be readily figured from the cross section of the beam by simply multiplying by .0088 which will give the square inches of steel in the cross section, and in this case equals .299 square inches in each 12-inch strip of roof.

To the ordinary lay mind concrete roofs of this thickness might be considered perfectly absurd, but the fact remains that they have been built in this manner and have stood the test.

In putting up such structures no special experience in this particular line of work is required. A simple knowledge of the correct methods of laying concrete is sufficient. Common labor can be used in this work, the placing of the steel being really the only thing requiring careful attention. It is advisable to mix the concrete very wet, and to avoid leaks in the forms.

In structures which must necessarily be watertight, several forms of waterproofing are being used; some rather expensive, some very simple. Probably the most effective and simple form is that of whitewashing the structure with a mixture of sand and cement after the concrete has hardened, and before it is thoroughly dried out.

Gas engineers generally are inclined to avoid concrete-steel work in gasholder tank construction, nevertheless everything is in favor of this form of construction. The effect of frost and the danger of leakage seem the principle objections, but as a matter of fact no trouble from these causes has been experienced in tanks that have been built in this manner.

In designing concrete-steel tanks the work is treated as a cylinder, and sufficient steel is allowed in the section to take up the tension due to the water exerting a bursting effect on the tank. The concrete is put in thick enough to thoroughly cover the steel and to keep the water from leaking out, but no strength is required of the concrete to insure the safety of the tank. It would be well to note the following advantages in concrete-steel tanks: First, they are everlasting; second, they entail no expense in painting; third, they very materially reduce the cost of keeping the water warm in winter; fourth, their cheapness; fifth they can be built while the guide framing and holder proper are being gotten out at the mills, thus reducing the time of construction of the holder nearly one-half.

There is no question but that in a very short time concrete-steel will play a most important part against masonry and steel in all forms of construction, and it is a very simple answer to the unreasonable demands of trades unions.

When the fact is considered that only a few years are back of the extensive use of concrete-steel in construction, and when it is considered that no setback has been given the material through the failure of structures or other causes, and finally, when it is remembered that the old Romans used this form of construction with unquestioned success, all skepticism should be removed.

A FRANCHISE for the supply of gas in the city of Lawton, Oklahoma, has been granted to the Bartsch-Gibier Company, whose main connections, if we mistake not, lead to St. Louis, Mo.

Electrolysis and Its Effects.

Mr. W. H. Spang, in a communication to the Brooklyn (N.Y.) *Daily Eagle*, on the subject named in the heading, writes:

The water supplies of cities of this country are again being surveyed by the National Board of Fire Underwriters and, wherever necessary, larger mains and other improvements are recommended for securing better fire protection.

It is becoming evident from recent developments throughout the country that the electric destruction of underground water pipes is becoming a very serious matter and must be remedied in order to maintain a proper water supply for fire protection.

In order that the underground electrical conditions of Brooklyn and Manhattan and their effects upon the water piping systems may be properly understood, the principal electric actions manifested in Brooklyn and other cities will be explained.

The Brooklyn City Railroad Company adopted electricity in 1892, and, during the following 2 years, quite a number of lead sheathings of underground telephone wires, also service water and gas pipes, were destroyed, especially near the power stations along the Gowanus canal and the East river, opposite the Navy Yard. Some of the renewed service pipes were again destroyed within 30 days.

During 1893 and 1894 there was similar electric destruction of service water and gas pipes at points near power stations at Saginaw, Mich.; Peoria, Ills.; Dayton, O.; Albany, N. Y., and other similar sized cities, after being subjected to the traction currents for about a year.

In such cases the current is sucked out of the earth, flowing to a main or mains, and the most convenient service pipe or pipes, which are pitted at the points where the current leaves the latter for the intervening earth to the rails and negative pole of the power station. Where a water or other main or underground electrical cable is convenient to the track rails, it is also directly pitted.

Since 1894 such electric pitting of metal pipes, etc., by the current flow has been prevented by the metallic connection of such negative pole or the adjacent track rails with the water and gas pipes and metal sheathings of underground telephone or other electrical wires, and in many cases of such connection of such pipes and sheathings.

This protection method is known as the drainage system, and while it will prevent pitting at such local spots, it causes an increased current flow over the water and gas mains within a great area or distance, attended with the gradual impairment of the mains above their joints which will finally be fully manifested in from 7 to 12 years by the general breakdown of such mains, as was the case at Richmond, Va., and other places.

The first electric railway in that city was installed in 1888, with the negative pole of the power station connected with the track rails, in the usual manner, and also with the water piping system, which prevented any electrolytic manifestation near the power station until 1896. In fact, the latter named connection concealed the great area of pipe destruction that was taking place undetected for 8 years within a certain radius of the first power station.

According to an inspection made in 1903 of the water mains of Richmond the electric damage was estimated at about $172,000, embracing the pipe lines destroyed near the power station and electric pittings at other points about the city.

The local pitting of underground pipes near power stations is insignificant compared with the greater destruction, and also more difficult to detect, caused by the flow of current from the positive pole of power stations, which, after traversing the feeder and trolley wires and car motors, leaves the rails and seeks moist earth via the most convenient service pipes and mains or metal sheathings of underground electrical wires.

Such a current flow to earth takes place when a car is about half a mile or more from the power station and even when in a town 5 to 8 miles or more distant therefrom.

From the Wallabout Canal to the Erie Basin there have been quite a number of service water pipes, also mains, badly pitted adjacent to the East River, and especially in the vicinity of Fulton Ferry. A pipe leading from the Jewell-Hecker mills into the river was destroyed in 17 days and many service water pipes along the docks in about 3 months.

Among the 6-inch bursted water mains due to electric pitting were three cases that deserve attention: One at the Cob Dock, in the Navy Yard, which was very badly pitted; another on Wallabout Place, near the canal, which was not only pitted but broken apart, and was accidentally discovered by the wheel of a truck breaking through the earth, which was hollowed out by the water flowing into the adjacent canal; and the third on Voorhees avenue, adjacent to Sheepshead Bay, the former and latter mains being, respectively, about 2,000 and 3,500 feet from the nearest electric railway. They were the outlet points for the traction currents flowing to water, after traversing not less than 12,000 feet of main, which are also subjected to pitting about their joints, inside and outside, which in a city like Brooklyn, where there are a number of such current outlets, may not be fully manifested for 12 or 15 years.

In Peoria, Ills., a 16-inch water main for a distance of about 500 feet, located between an electric railway and a filtering bed along tne Illinois river, and about 2 miles from the power station, was rendered useless within 9 years by pitting about the joints caused by a concentrated traction current flow over the main to moist earth.

Judging from the character of the pitting of the three 6-inch mains in Brooklyn referred to, water must have escaped, undetected, into the adjacent waterways from 1 to 3 years. There are, beyond doubt, similar other leaks in Brooklyn which contribute to the short water supply and low pressure.

There have been similar water main leaks at Bayonne, N. J., adjacent to the Kill von Kull and New York Bay, 8 miles from the power station at Jersey City. The badly pitted 12-inch main which supplies the oil and other works and Constable Hook burst last year and caused their shutdown until the break was repaired.

Pipe destruction has also recently been reported at Fairfield, 5 miles from the power station at Bridgeport, Conn. In fact, it is becoming general at points in cities and towns along electric railways, distant from power station.

In Syracuse, N. Y., four lengths of a 10-inch water main adjacent to a pipe conveying brine, were destroyed, which is, however, only a small portion of the damage attending all such cases, where traction currents flowing from rails to water and gas mains seek adjacent long lines of pipe conveying oil, natural gas, brine, etc., and also the sheathings of underground electric cables which are laid across waterways and swamps.

The electrical relation existing between the electrical railways, underground water and gas mains in the Greenpoint section, and the oil pipes of the Bushwick oil works laid between the Bushwick Inlet and Newtown Creek, should be thoroughly investigated. Likewise, the relation existing between the Second, Third and Ninth avenue electric system in Manhattan and the oil supply pipe which crosses the North river, Central Park and the East river to Long Island.

Over the subway, west of Columbus avenue, all pipes are close to each other and near Third avenue all the underground fire alarm wires controlling the southern part of Manhattan, are adjacent to said oil pipe.

The underground electrical status of Manhattan can be compared to that of Wheeling, W. Va., where there are three main streets or avenues extending the entire length of the city parallel with the Ohio river and under which are laid the water, gas and natural gas mains. The electric pipe destruction was so rapid there that it was found necessary to employ insulating joints at intervals with the natural gas pipes, which is a dangerous remedy in any city, due to the destructive effects of lightning discharges upon such joints.

Lightning takes a prominent part in the electrolysis problem. It creates fissures in concrete, asphalt and all other insulating material employed beneath electric railways. It damages underground electrical conductors and their wooden and vitrified conduits. On Fourth avenue, near Forty-first street, Brooklyn, a service water pipe was damaged by the current from an underground wire in a vitrified conduit, and on the same avenue near Thirty-ninth street, another service water pipe was destroyed three times within a year by an underground wire in a wooden conduit. The primary cause in both cases was undoubtedly, lightning. There was similar underground impairment of conductors connected with the Brooklyn elevated systems of last year.

In Fitchburg, Mass., the joints of about 2,000 feet of cement lined water pipe were destroyed on each occasion during three different thunderstorms, and such destruction was the principal cause of the failure and abandonment of that class of water pipe at Fitchburg, Lynn, Woburn, Arlington, Mass., and other places.

Lightning has a great attraction for a water standpipe and its connecting pipes, invariably resulting in the impairment and blowing out of pipe joints. The average gas leakage loss of 355 gas companies in this country was in 1900 about 14 per cent. of the total output, of which a certain percentage is due to the general employment of gas pipes in connection with the lightning arresters of telephone, telegraph and other electrical circuits, and also with lightning rods in the cities.

The electric protection of underground pipes is, therefore, a complex problem, but, nevertheless, the proper remedy for such electric causes was determined some years ago and its general introduction has, prin-

cipally, been delayed owing to the erroneous theory advanced in 1892 that the traction current utilizes the underground pipes in a shunt circuit part pipes and part surface earth intervening between the pipes and rails. Most electric engineers still cling to this theory, although it has been fully exploded by the actions of the traction currents as manifested in every city and town and above explained.

Central Station Distribution.

In a paper read by Mr. C. H. Williams, of the Madison (Wis.) Electric Light Company, at the last meeting of the Northwestern Electric Association, the author discussed the elements affecting costs and losses in distributing circuits. In starting his treatment of the subject, Mr. Williams stated that engineers were gauged by the results they obtained, and in this particular line the gauge was most likely to be graduated in dollars or dividends, and the dividends will not be forthcoming unless good service is rendered, while good service cannot be secured without following sound engineering principles.

The load which is carried on the several circuits of a distributing system depends upon local conditions, the two most important of which are the average length of the feeders and the operating cost of generating the current. The copper losses in the feeders for any assumed load, figured on the operating cost of generation, compared with interest on line investment, fixes the load to be carried. From an example cited, the author shows that one cannot predetermine a certain drop which shall be allowed in every case, but each case must be worked out for itself. In secondary work the practice is becoming more and more common of making an interconnected, 3-wire network, which allows of a close secondary regulation throughout large districts, and also does away with a large percentage of idle transformer capacity, which, consequently, reduces the iron losses.

Conditions, such as active lights per 100 feet of territory fed, determine the proper sizes of transformers and feeders, and to facilitate ready interchanging, and prevent the necessity of carrying half a dozen different sizes of fuses and supplies, multiplicity of sizes of transformers and secondary feeders should be avoided.

Determining or estimating the load, the sizes of transformers depend upon whether the load is scattered over a large territory, or bunched within comparatively narrow limits, and the difference between the interest and depreciation on the transformer investment, together with the cost of current for iron losses for the several sizes of transformers under consideration, on the one hand, and the corresponding interest and depreciation on the investment required for the secondary copper, together with the secondary I^2R loss on the other hand, determines the size of transformer to be used.

It is good practice to adopt some standard size of transformer for residence lighting which covers the conditions for the larger part of the territory under consideration, and to adopt a larger size for the business districts. The number of sizes will then be cut down to two, and a careful study of the conditions will generally demonstrate that this is advisable.

The matter of regulation may be figured for the cost of lamp renewals—provided an accurate record is obtainable of the number of connected lamps, whereby the consumption per lamp per year may be calculated. If we assume the use of 3.5-watt lamps, and have nearly *perfect* regulation, and find the average consumption per lamp per year to be 20 kw. hours, the cost of renewals for each lamp figures out to be the cost of the lamp, plus the cost of labor of changing and photometering each lamp, times the connected load in lamps and on the assumption of a 750-hour life, the actual cost for lamp renewals for the system is $ 00435 per kw. hour. With a variation of voltage of but 1 per cent. the life of the lamp drops to 615 hours and the cost of renewal, as shown by the author, is $.00536 per kw.-hour, which is an increase of .00101 per kw. hour, or for a station with the 42,000 lamps connected with an average consumption of 20 kw. hours per year, and money available at 6 per cent., $14,140 could be spent to better the conditions of regulations if this 1 per cent. variation could be wiped out, the interest on this amount just equaling the money saved by the decreased lamp renewals.

With 2 per cent. regulation, the cost would be 1.48 times the above, and with 4 per cent. regulation the cost for lamp renewals would be 1.48 times that for 2 per cent. regulation. The matter of regulation is a very important one to the central station, in addition to the consideration of the question of satisfactory service.

Turning to the station as the source of regulation, it is found that the only way possible to accomplish it is to install sufficient feeder regulators on the various circuits, and to provide either compensating voltmeters or pressure wires, regulating each circuit separately by hand. In some stations automatic regulators may be made to take care of the changes by properly changing the excitation of the generator, but in the larger stations where of late large polyphase current machines are being operated, it is next to impossible to keep the load sufficiently well balanced to maintain equal secondary pressures on the different phases without the aid of circuit regulators working through a considerable range.

In Madison the regulation is obtained by supplying two of the six circuits with feeder regulators, and after paralleling the generators and exciters, regulating them as one unit automatically from a center of distribution of one of the remaining circuits through a pressure wire controlling an automatic regulator, and very satisfactory results are obtained in this way.

The automatic regulator used at Madison is a Chapman voltage regulator, built by the Belknap Motor Company, and 5 years' use has proved its worth. It consists of a relay connected to a pair of No. 6 pressure wires run to the secondary center of distribution of a primary circuit; a rheostat is connected into the fields of one of the exciters, and a pair of working solenoids operate the rheostat. An arm carrying contact shoe is attached to the cores of the solenoids, the latter having two windings, one of which is fed with the relay current, and this, in turn, induces a current in the secondary in the same direction, thereby preventing sparking.

Another item of importance is the inherent regulation of a transformer, and by regulation is meant the ratio of the drop of secondary voltage from no load to full load. With transformers of poor regulation on the circuits, difficult problems will enter when an endeavor is made to give all consumers equal and normal voltage, which would necessitate pronounced changes in secondary feeders, or a still more objectionable change in a substitution of lamps of different voltages and efficiencies.

The insulation having been proven satisfactory, the interest on the investment for the transformer, together with the core loss in kilowatts, times 24 hours per day every day in the year, times the generating cost per kilowatt-hour, and the full load copper loss times the equivalent number of hours during which the transformer would operate full loaded, times the generating cost per kilowatt hour, give the data necessary for finding the actual cost per annum of operating each type of transformer, when operating on a 24-hour lighting load, so that the other conditions being the same the most desirable type is determined.

It is apparent from the foregoing that the conditions under which the transformer is to be operated have much to do in determining the value of the different factors; for instance, the iron loss goes on as long as the transformer remains in circuit, while the copper loss is nil so long as no current is flowing, and increases with the square of the current as the load is increased.

If, then, a transformer is to be selected for a lighting load where it is on the circuit 24 hours per day, and furnishes a total amount of power equivalent to its full load for but 2 hours per day, it is of first importance, so far as the losses are concerned, to obtain a transformer with a low iron loss, and, on the other hand, if the transformer is to be fully loaded all day, it is much more essential that the copper loss should be as low as possible. In any case, the two losses must be taken into consideration, and the expenses figured for each before an intelligent selection can be made.

Quite recently there has been placed upon the market an instrument designed by Mr. C. W. Humphrey, which is invaluable in determining the division of load on the several branches between transformers working on an interconnected, secondary network. The instrument consists of a small series transformer, the coil of which is placed on an iron ring, so arranged that a small segment of the ring can be opened and closed over the conductor carrying the current to be measured. The transformer proper, which weighs about 2 pounds, is connected to 60 feet of flexible duplex cable, the free ends of the cable being fitted with terminals suitable for clamping in the binding posts of a portable ammeter. The ammeter, which in reality is a milli-voltmeter properly graduated, reads direct the value of the current flowing in the conductor.

By means of this instrument a large system can be checked up in a single evening. One man takes the small coil to the top of the pole and snaps it successively onto the two outside wires of the 3-wire secondaries leaving the transformer, and another man at the foot of the pole on the ground reads and records the load that each side is carrying. By the use of this instrument it is shown that no matter how carefully an estimate may be made as to what the probable division of

load will be, that gross errors will be found, one transformer carrying much more load than was intended for it, and one side of the system may be found overloaded, while the other will be found to be underloaded.

In connection with this method of keeping connected load records, a card system adapts itself admirably. The system in use at Madison is described in detail.

A record is kept of all meters sent out on each circuit, their make, size and type, and a record of their test, and from this data the meter shunt loss may be easily calculated for each month, a careful test having been made of a sufficient number of meters to obtain a constant for the shunt loss of each size and make and type of meter.

The average shunt loss for late type alternating current lighting meters may be considered to be about 2½ watts, and as the average loss is so small, one would naturally think that this loss could almost be neglected, but this is far from true; for instance, the station under consideration had one circuit where the meter shunt losses aggregated more than did the transformer core losses, being for a certain month 5.93 per cent. of the output for meter shunt loss, and 5.01 per cent. for transformer core loss, and in many cases these items will be found equal. In the case of T. R. W. type of meter, such as are used on most direct current power circuits, considerable unaccounted-for current may be brought to light by making it a rule to give the meter jewels a careful overhauling after each run, consisting of 400,000 turns of the shaft, which may easily be determined from the reading of the meter.

The lost and unaccounted-for current, besides arising from faulty registration, leakage and theft of current, may come from lost records. Few plants will find that a careful checking over of their circuits will not bring to light some consumers whose names are not upon the books.

The data being collected for the several circuits, it is an easy matter to determine where the trouble lies. Such information will show at a glance whether or not line losses are excessive, or core losses too high, or whether all transformers are properly loaded, and, in fact, will enable changes to be made so that the lines may be operated at the highest possible efficiency.

As an illustration is given a tabulation as worked out for the Madison plant for an October day.

every lamp is taken out of every socket and good lamps placed in their stead. The lamps which are removed should then be cleaned and photometered, and all lamps which fall below 95 per cent. of their original candle power should be culled out as seconds, to be used in attics, garrets and cellars, while all falling below 80 per cent. should be placed in the junk pile.

Mr. Almert asked Mr. Williams as to the cost of keeping such elaborate records as he recommends in this paper and also what class of help he used. In collecting data on equipments on his customer's premises recently, he found the expense was considerable, but he felt that he would be repaid for it. However, if he were to keep such elaborate records as Mr. Williams, the cost might be prohibitive. He doubted whether standardizing of transformers could be accomplished in many properties as Mr. Williams had been able to do in his community.

Mr. Williams replied that more labor was probably put into the determination of the resistance losses on his circuits than in anything else. This took the entire time of one man for three months. After the information was once recorded, it required only a small amount of labor to keep it up. Any additions or changes to the lines are recorded and the corresponding resistance changes in the circuits recorded at the same time. The meter man makes records of the losses in every meter that goes out. The superintendent of distribution tests all transformers that are put out. The division of load between the two sides of the 3-wire secondary network and the division of load between transformers on a network is determined almost entirely by means of the series transformer devised by Humphreys of Denver, which can be clamped over the conducter in which the current is to be measured at any point. During the time of heavy load in the fall, some of these readings are taken every night.

The standard sizes of transformers adopted at Madison were 5 and 15 kw. capacities, which suits the case at Madison almost exactly. The determining of the resistance losses is done by calculation from the size of the wire and length of the circuit, the current in each circuit being determined by tests under various conditions.

Mr. Almert questioned whether the measurement of current flowing from a transformer or through a feeder by means of a series transformer as described by Mr. Williams would give good results because of the difficulty of taking the measurement just at the proper time. He asked

Circuits.	Output.	Core Loss.	Per Ct.	Cu. Loss.	Per Ct.	Meter Shunt Loss.	Per Ct.	Primary I^2R Loss.	Per Ct.	Secondary I^2R.	Per Ct.	Total Losses.	Per Ct
1.....	421,000	28,488	6.76	3,461	.82	14,916	3.54	19,006	4.51	1,456	.55	67,327	15.98
2.....	522,400	19,752	3.78	6,379	1.22	19,092	3.65	14,103	2.7	2,604	.49	61,330	11.84
3.....	300,000	28,680	9.56	4,313	1.44	23,316	7.77	10,744	3.58	1,969	.66	68,749	22.91
4.....	413,000	20,712	5.01	3,208	.77	24,504	5.93	20,079	4.86	6,404	1.55	74,907	18.12
5.....	477,600	42,576	8.55	3,653	.73	18,720	3.76	21,817	4.38	3,297	.68	90,163	18.10
Total.....	2,134,000	140,208	6.51	21,014	.97	100,548	4.67	85,749	3 98	15,830	.72	363,076	16.85

The losses on the 500 volt power at the same station for the same time were as follows: Output, 1,183,400; I^2R loss, 42,644; per cent., 3.6; meter shunt loss, 63,571; per cent., 5.4; total, 106,235; per cent., 9.

The question of the proper selections of incandescent lamps is very important one to the central station manager. It is undesirable to have more than one voltage and more than one wattage of lamps in use, as the lamps are sure to get exchanged and mixed up, increasing the cost of lamp renewals where the low voltage lamp gets installed in place of the higher voltage one, and creating a just cause for complaint where the lamp is operated at a voltage lower than that for which it is designed. Probably nine-tenths of the customers, if left to purchase their own lamps, would buy a low efficiency lamp that would burn 1,500 hours or more, without considering that to secure the same candle power they would be paying for about 30 per cent. more current. If the matter is left to the lamp salesman he will recommend high efficiency lamps with the corresponding shorter life, because this will naturally increase the lamp sales in his territory.

Assuming that the lamps are renewed at the end of their useful life, or at a time when they have fallen to 80 per cent. of their original candle power, it is shown that the 3.5-watt, 16-candle power lamp would cost $.0622 more per annum for lamp renewals than would the 4-watt, but the 4-watt lamp would cost $.2288 more per lamp per year for additional current and interest and depreciation on the additional investment, so that, by the use of the 3.5-watt lamp there would be a saving of $6,997.20 per annum on a connected load of 42,000 lamps.

It is poor policy for a lighting company to allow old lamps to remain upon their lines after the same have fallen to 80 per cent. of their original candle power, as the illumination from such lamps cannot help but be poor and unsatisfactory, and the consumer will have a just ground for complaint. To prevent the existence of such a condition it is necessary for a company to make periodic wholesale lamp renewals wherein

whether something like a Wright demand meter would not be the thing to use in that case.

Mr. Williams replied that he had used many Wright demand meters, but because of the time necessary for them to register the full amount of current the load peak might go up and come down again before the meter had time to register. He had found that it took about half an hour to get a complete registration on such meters.

Mr. Almert still thought that for general use the introduction of a device like the Wright demand meter or a recording ammeter for such work was essential.

Mr. Williams said that they made frequent use of Wright demand meters on the primary side of a transformer, but the ease with which the series transformer could be used without any interruption of the circuit made it advahtageous.

A Works' Contract that will Interest Gas Engineers.

As a contract, which has just been completed for an important gas works well-away from America, possesses many features of interest to gas men, some description thereof will undoubtedly be welcomed by our readers. The specific place is Sydney, N.S.W., and the contractors for the task were Messrs. Graham, Morton & Co., of Leeds, England. Prefatory to the details of construction a word or two of recital as to Sydney itself may not be out of place. To-day Sydney ranks itself as the third city dominated by England, the ranking being figured on the annual rating value. Although in an historical sense it is virtually less than usual time in phenomenal growths of centers of population that Captain Phillips pitched his tents at the head of "Tank Stream,"

under prehistoric trees, and as yesterday since the population and the new era came with the gold discovery. However, here are some facts of the day respecting the place:

It has been estimated that the quantity of coal available in New South Wales is, at the most modest estimate, 115,346,880,000 tons. Frequent analyses of the coal in the neighborhood of Sydney all serve to show that it is of good quality and suitable for steam raising and smelting purposes. The depth of some of the measures underlying Sydney is so great that on good authority it may be stated there is very little danger of their ever being worked out. New shafts are continually being sunk, and new plant of the most modern description erected, while several collieries are already fitted up with the finest appliances, for economical and efficient work, supplying Government railways and also the Navy, with large quantities of superior steam coal. But now to our immediate story of the supply and delivery of a fine, duplicate, coal-handling plant to the Australian Gas Light Company, Mortlake Gas Works, Sydney, by the heretofore named contractors, and built to the designs of Mr. Thomas J. Bush, Chief Engineer; the Resident Engineer to the Gas Works is Mr. Bertram Stanway. Many English engineers will remember Mr. Stanway when he was assistant to Mr. Ralph Herring, during his construction of the Granton Gas Works, Edinburgh, Scotland.

The contract included the supply and delivery of 2 receiving hoppers, two standard 4-roll crushers, two 12-inch lattice-braced elevators, two 16-inch rubber belt conveyors, two coal bunkers, with the necessary structure for supporting the same, two 17½ brake horse power steam engines, with the requisite shafting and gearing for driving the entire plant. The above is a general description of the contract placed with the Leeds firm which they have just carried out successfully, and on which they may, therefore, be congratulated. As some further details of the various portions of the plant will probably be of interest, these are appended:

Starting with the hoppers, these are built up of ¼-inch plate, supported by means of 6-inch by 2½-inch channels, built into the sidewalls of the pit and attached to the hoppers by means of angle iron framing.

Turning our attention to the two standard, 4-roll crushers, these are built up of steel side and end plates, firmly bolted together, and provided with shafts, cast steel tooth rollers, guide plates and the requisite gearing, etc., for working them. The structure on which they are supported consists of 8-inch by 3¼-inch channels, built into the wall at one end and supported by 8-inch by 6-inch cross joists at the other. The crushers are, of course, securely bolted to the channels. The shoots provided for the elevator boots are constructed of $\frac{3}{16}$-inch plate throughout, the side plates being flanged and riveted to the ends, the result being in each case a very substantial piece of work.

The two elevators are of the 12-inch standard, lattice-braced type, 58 between centers, each consisting of a suitable cast iron boot, in which is arranged the adjusting gear for taking up and serving the length of chain. A cased-in framework of angle iron runners, and angle iron stanchions, lattice-braced throughout, completes the design.

The driving and trailing end fittings are of cast iron, sprocket wheels, mounted on bright steel shafts, provided with the necessary pedestals and loose collars, and also with adjusting screws for taking up and adjusting the length of chain.

One strand of chain is supplied to each elevator, tightly stretched over the end drums, thereby forming a continuous travelling chain, to which, at intervals of 18-inch pitch, are attached the buckets and skidder bars. One $\frac{3}{16}$-inch plate, wrought iron breeches' shoot is provided to each elevator, being built up of $\frac{3}{16}$-inch plate, and arranged with flap-door, spindle and lever mechanism for diverting the coal, either on to the belt conveyor or into the coal bunker, as may be desirable.

Next in order is the coal bunker construction. The bunkers are of wrought iron, built up of ¼-inch plate throughout, with 2½-inch angles in the corners, the butt joints of the plate being formed by means of 5-inch by 3-inch tee irons. Each bunker is fitted with a slide door and operates in the easiest possible manner. The structure for supporting the bunkers, as intimated, is provided complete, together with the necessary structure for supporting the elevators; the latter consists of 6-inch by 5-inch rolled steel joists, stiffened by lattice-bracing.

Each of the elevator pits is covered $\frac{5}{16}$-inch, wrought iron checker plates suitably supported. Access to the pits is obtained by ladders some 13 feet in length.

A word or two as to the belt conveyor. This is 30 feet 6 inches between centers. It consists of two end drums, made up of cast iron sides, with wrought iron body plates, each drum mounted on its shaft, the trailing shaft working with adjustable ends, and fitted with adjusting screws for tightening the belt. The belt itself is of the Graham rubber type (flexible rubber and canvas of the finest quality, thickened with additional rubber in the center portion) so that when material is deposited in the through line of the belt it is carried on the increased portion of the rubber. These belts are manufactured in large presses by experienced men, great care and attention being bestowed on the various processes of production, whereby the desirable ductility, so necessary for obtaining the best results in working long lengths of belt is secured. On the top or carrying side of the belt it is supported by Graham's patent inclined idler rollers, made of cold drawn steel tubing and fitted with hollow, self-lubricating spindles throughout, adjusting blocks, etc. These rollers are pitched about 5 feet apart. On the bottom or return side the belt is supported by means of flat rollers, pitched 10 feet apart, mounted on 7-inch by 2-inch pitch pine battens, bolted to the structure. The belt drums, one central and two side, are built up of cast iron centers with wrought iron tubes mounted on tube spindles, and provided with screw lubricators. They are placed at an angle of about 30°.

The structure supporting the belt conveyor is built up of 6-inch by 3-inch channel iron runners, ultimately attached to the wrought iron coal bunkers. In addition to this belt conveyor the contract covers the supply of a second conveyor, precisely similar, to replace the existing belt conveyor, should it at any time be desirable to do so, the plant being in duplicate. Another advantage of this duplication is the possibility of feeding either side of the retort house from either plant.

At this point a word as to the gearing, which is also supplied by the contractors, will be of interest:

A short shaft is coupled to the end of the engine shaft, from which, by means of a belt drive, a 4-roll crusher is actuated. From the end of the same shaft a second, connected by gearing, is carried up the side of the elevator, which by means of bevel gear drives the elevator. The belt conveyor is driven by means of a chain from the elevator head shaft.

The engines for driving the machinery are each of 17½-brake horse power, of the well-known horizontal type. The cylinders are of 9-inch diameter by 12-inch stroke, and each running at a speed of 140 revolutions per minute is capable of developing the horse power mentioned, with 80 pounds steam pressure.

To be Concluded.

(Concluded from Page 171.)

On Batteries with Reversible Boosters.

By C. Turnbull.

Size of Cells.—Given a booster with the above properties it is not difficult to arrive at the size of the cells. Thus, with an output of about 3,000 units per day of 16 hours we can do it with a generator which will do 300 kw. as ordinary full load, with, say, a 25 per cent. overload capacity to meet excessive and occasional rushes. As we can now get economical triple expansion engines or turbines which will run economically for long hours at full load and that will give off overloads either by means of valve gear or by working as compound engines, this part of the problem is easily solved. We must then put in a battery which will be large enough to meet the maximum load of the station when running in combination with the generator. Where the hours of actual load are longer or shorter than the 16 hours mentioned above, or where there is little or no load during part of them, then the problem can be solved in a similar manner. Given, however, a booster which will work in harmony with its generator as above, the solution will not be difficult, and a good deal can be done by varying the hours of running of the generator to suit. In buying cells under maintenance, it should be arranged that the circuit breaker should be set as high as possible. This is really unobjectionable, seeing that heavy discharges are only momentary, and, further, the battery usually is not run down at all in working.

Type of Cells.—The actual work done by the cells when working with a reversible booster is very little. For although the curve of charge and discharge looks large enough in importance when it is examined on the recording ammeter chart, still the peaks integrate to very little. We, therefore, want a cell which will do with very heavy discharges, and also with considerable charges, but that does not necessarily have a large long-hour capacity. Durability is more important than efficiency. As a matter of fact it is well known that a cell which receives charges and discharges at short intervals has an extraordinarily high efficiency, and a slight reduction in this if it gave increased durability would not matter. I have been informed by one of our leading accumulator firms that a cell to meet those requirements can

be made and maintained at about half the ordinary price if it be asked for, and I hope that such will be on the market in the near future.

Space for Additions.—It is a great advantage to have the cell boxes large enough to allow of the addition of more plates. This enables the size of the battery to be kept down, as it is easy to increase its capacity. If, however, more plates are added, then it is not desirable to simply put the new plates in parallel with the old ones. Old plates should be taken from some of the cells to make up the additional number required in the other cells, and the cells thus depleted should be made up entirely with new plates. The space at the side is useful in assisting the much desired circulation of the acid. It also enables the cells to be inspected by an inspection lamp on an L-shaped stick. This lamp put under the plates shines upwards and shows any shorts clearly.

Space at Bottom.—The space at the bottom of the cells should be ample, about 6 inches or so, so as to obviate frequent cleaning.

Number of Cells.—The possible variation of cell voltage is from 1.8 to 2.7 volts per cell, the last figure being obtained with the fortnightly overcharge, which makers recommend to be given to the cells. In ordinary working the variation is from 1.9 to 2.5 volts. Provided that the booster is arranged to prevent the current from coming back on to the generator, the number of cells may be varied considerably. I think, however, that 250 cells is a suitable number where the bus bar pressure is between 500 and 550 volts. If fewer cells be used, a good deal of work is thrown upon the booster to pnmp the current out of them, and if more cells are installed there is a danger of the current coming back on to the generator if they be floated on the line without the booster when fully charged.

Instructions for Running the Battery.—This is a matter of great importance, and, unfortunately, battery makers usually give little assistance. It will be seen that it is necessary in working to insure that the battery has just the right proportion of current to put into it. Meters are of some assistance towards this end, but they must not be relied upon too much. It is doubtful if meters are quite accurate on the violently changing loads of a traction battery. Furthermore, it is likely that the effect of a discharge on the battery varies with the rate and also with the state of discharge that the battery is in. One hundred ampere hours taken out of a battery just freshly charged will not need the same extra percentage to be put back that the same amount would need from a battery well run out—at least, I think not; indeed, so long as the load is of such a kind that the battery gets a charge immediately after a discharg e—as happens when working with a reversible booster—then the excess percentage of charge over discharge in ampere hours need be very little.

The advice is sometimes given that the booster should be worked so that the battery is charged every night at shutting down time. This is impracticable without an undue amount of attention. The most practicable way that I have found is as follows: During the morning when the generator is started up, there is usually a slack time, so that it can be arranged that the battery is mainly charging. The battery attendant should be in the battery room now, and he should go around and see that every cell gases up at the same time. He should watch the battery when it is gasing, and, at the same time, top up any cells with water if necessary. The water can be put in by a long glass tube, about 1½ inches in diameter, with a bell mouth. This will enable the water to be put in at the bottom, and it can be stirred about and well mixed with the acid. The amount of gasing and volts per cell necessary on the daily charge should be determined by the battery makers, whose assistance should be freely requisitioned at first start up. When the cells are full up, the attendant should inform the engine room staff, so that the booster can be regulated, so that the battery can be discharged for a time rather than charged. When a little current has been run off, the adjustment can be made so that charge and discharge are about equal or as needed. This method of working the battery needs a minimum of attention and will be found very satisfactory in practice. Once a fortnight—if required by the makers—an extra charge can be put in which will bring the voltage up to 2.6 or 2.7 per cell. This should be done at a quiet time, when the charge can be put in fairly steadily. The volts of each cell can then be taken on the top of the charge. The gravities of the cells can also be taken at the same time. The gravities can be relied upon to some extent to tell if the cells are getting their proper charge, but still these are affected by the addition of water to make up for evaporation. If a maintenance scheme is entered into, it should be on condition that the battery is to be worked on lines like this, and not on lighting battery lines.

Maintenance.—The question of the maintenance of batteries by makers is a thorny one. If the makers are good, substantial and decent people, then there is some assurance to the owner of the battery in having a maintenance. Otherwise, it may happen that after several years of maintenance have been paid that when repairs are needed the makers get out of their agreement by one of those curious clauses with which they fill their agreements. I mean, for instance, such a clause as that which states that the payments are to be made to the company without demand. It is possible to reduce the amount of the maintenance payment by stipulating for the battery to be kept up to, say, 90 per cent. of its original capacity, instead of the full capacity, and this is usually quite enough for reversible booster work. Indeed, with this proviso, the unkeep rate for a battery should be extremely low. The maintenance agreement should be settled as to terms before the order for the cells is definitely placed, as this will enable a better bargain to be struck. The user of the cells should then stipulate for six month's use of the cells before deciding whether to enter into the maintenance scheme or not. It is also desirable that the agreement should last over a long term of years—say 10—but with the user's option of terminating, say, after 5 years.

Water.—The question of water should be settled before the contract is placed. The makers usually stipulate for pure water only to be added to the cells, but if the town water is good this is allowed. If this is not good then the user is in a quandary as to how to make up the evaporation. Condensed water from a boiler is not always suitable, as it may contain boiler compounds, if such be used, or iron. Makers do not always help in the matter. Thus I know of one case where the engineer asked them to provide a distiller to provide make-up water, and they offered one, after several weeks of correspondence, for about $2,000. Rain water is often too impure. I think that a simple distiller could, however, be made by using a gas jet under a boiler. The steam would go through a worm, and would be cooled by water in a tank. After the worm had gone through this tank it would go through a second tank. The boiler and the two tanks would be connected by a pipe so that the water would stand in the same level in all. This would cause the boiler to be automatically fed with hot water. A tap could run into the last tank to keep up the level, and also to provide cooling water.

Battery Room.—It is often stated that battery rooms should be well lighted. Actually too much light in a battery room is bad, as it renders cell inspection difficult. The room should be rather dark, with good artificial lighting. The wiring may be done on insulators. At intervals lamps should be provided on long flexes of Lyric 3 25 R.C. wire for looking into the cells from above. Hooks should be provided to hang these lamps on when not in use. I have found acid-resisting paint liable to chip off a concrete ceiling, but wood varnished with acid-resisting varnish has stood better. The ventilation should be good, but of a nature to prevent flies and dust from coming in too freely.

Milking Booster.—This should be run off the lighting circuit so as not to be shut off if the main circuit breaker of the traction generator is blown. It is a debatable point as to how the leads should be run for milking up the cells. In the diagram I show them run under the grating on the floor, being supported on insulators. The flexible leads can be connected by means of screwed plug handles. A small switchboard can be fixed in one end of the room, or possibly in a small room provided for the purpose. Where the cells are on two floors the switchboard should be provided with one pair of switch fuses only, to connect either the upstairs leads or the downstairs leads on to the bus bars. The use of a single pair of switch fuses prevents any attempt to milk up two parts of the battery at once, as, of course, only one pair of flexible leads is kept in a room. The booster can be put in a convenient place, but the regulation of its volts can be done from the battery room. The booster may also be arranged to provide heavy currents for meter testing purposes. The board should have a polarized ammeter and a voltmeter with a paralleling and other stops on the switchboard.

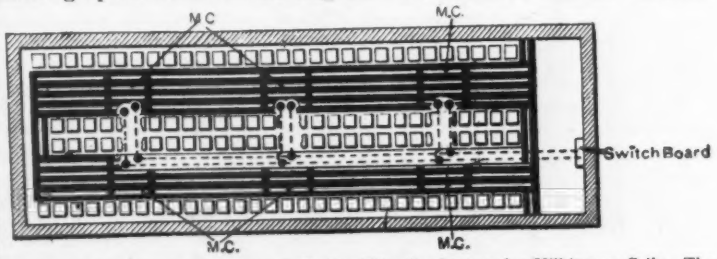


Diagram Showing Arrangement of Trolley Wire Conductors for Milking-up Cells. The Grating is Shown Broken Away to Show the Trolley Wire which is Underneath. M.C. Indicates Movable Coves by which Plugs are Got at.

Grating.—The grating for the battery room floor can be made of rough wood dipped into melted pitch. This makes quite a cheap and satisfactory arrangement.

Reversible Booster Switchboard.—The breakers of the booster motor and battery should be on the live side, but most of the rest of the instruments on the board may be on the earth side. The motor breaker should be arranged to shut off the battery current, if it comes out so that the booster may not race owing to the battery current running through it. On the other hand, it is desirable to have the breakers arranged so that the blowing of the battery breaker does not stop the motor.

Meters.—Wattmeters may be used with shunts taken off the bus bar, so that they virtually become ampere hour meters. I have tried oscillating meters, which have the advantage that they do not need any pawls to stop them from running reversely. I think that mercury electrolytics or some shunted ampere hour meters with a small drop might be used. One shunt would do for both In this case the auto switch for putting either one or the other in circuit, according as the battery was charging or discharging, would be simply a mid-zero ammeter type of instrument, only that the pointer would have a contact on the end. This contact would swing up against one or the other of fixed contacts, and so direct the current into the right meter.

Testing of Meters.—It is not essential that the integrating meters should be absolutely correct, but it is essential that they should agree with each other, or that their differences should be known. They can easily be tested for this by simply reversing the connections of one so that they both read for charge, or discharge, for a day or two. The readings thus got will show whether the meters are agreeing.

Shunts.—The abomination of several shunts in series—one for the ammeter, one for the recorder and one for the integrators—should be avoided. One shunt should do for the lot, or if two in series be used, then the instrument having the heaviest drop should come off the combined resistance of the two shunts. In this latter case the two shunts in series should be soldered together, so that the combined resistance could not be affected by bad contact.

Arrangement of Plant.—In some stations I think it would be a good thing to couple the booster right on to the main generator shaft, so as to save motor losses. In many cases I think it would be well to run traction and lighting dynamos in tandem on the same engine.

Where a reversible booster was in use the load on the traction generator would be steady enough to prevent flickering on the lighting boards due to variations in the engine speed. Two ideas are possible—either the generator can be looked on as a traction generator, in which case the traction dynamo would be equal in capacity to the engine, and the lighting dynamo would be equal to the day load on the lighting board; or the lighting dynamo can be of the engine capacity and the traction one smaller. At night or on the peak loads, of course, when desired the loads could be separated out. The lighting dynamo could have the mid-wire connection through choking coils, which would obviate the running of a balancer in the daytime. Given, say, some 200 kw. on the traction and, say, 100 kw. on the lighting all day long, then the combination would provide quite a good load for a 400 kw. or 500 kw. engine. If the condensing plant were run direct off the engine shafting by chain or other gearing, we would have a very economical omnibus plant for many stations. Of course, one may say there would be a lot of eggs in one basket in case of breakdown, but then plant does not break down now as it used to, and, of course, the ordinary standby plant would be necessary as it is now. The amount of current that runs to waste nowadays in running balancers and motors for various purposes is so enormous that it is worth while to do something to save it.

Conclusion.—I have written this paper at somewhat short notice, although, of course, the subject has been in my mind for a long time. Had I had more time it would have been possible to provide more diagrams, but I hope that the absence of them will not be unduly felt. Indeed, the style of the diagrams necessary to illustrate a paper of this kind is so well known that it is doubtful if they are necessary. I can only hope that the contents of the paper will be useful and interesting to all concerned in matters of this kind.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Laclede Firebrick Manufacturing Company, of St. Louis, is putting in 2 benches of 6's, half-depth type, for the plant that is being erected at Chickasha, I. T. Mr. Lawrence Martin, the President of the Chickasha enterprise, is confident that he is in charge of a property that will pay from the start.

MR. FREDERIC EGNER, of Norfolk, Va., has been appointed Cousulting Engineer by the authorities of Fredericksburg, to overlook and supervise the construction of the new coal gas plant there to replace the present superannuated one. The plans call for a plant up to an output of 100,000 cubic feet per diem, and the installation of 2 benches of 4's on the inclined system will be erected.

A CORRESPONDENT in San Francisco, writing under date of the 24th inst., says that Messrs. S. F. Alden & Co., Rialto Building, that city, who are agents on the Pacific Coast for the Davis & Farnum Mfg. Company, of Waltham, Mass., have effected the sale of 3 steel gasholders, with a total capacity of 1,400,000 cubic feet, to the California Gas and Electric Corporation. The shipping weight of the material for those holders will exceed 2,000,000 lbs., or about 50 car loads. The contract price approximates $125,000. The holders are parts of the equipment for the generation of power to operate the United Railroads system.

DURING 1904 the Gas Machinery Company, of Cleveland, O., dealt in one way or another on machinery and supplies account, with 48 separate gas companies in the States and Canada.

BIDS for the public lighting of Trenton, N. J., will be opened tomorrow evening. It is not likely that much competition over the service will be in evidence.

AT the annual meeting of the Cambridge (Mass.) Gas Light Company the regular semi-annual dividend of $5 per share was declared, the former officers were re-elected, and it was determined to make considerable expenditure on plant betterment account.

THE authorities of Detroit have employed Prof. Edward D. Campbell, of the University of Michigan, to determine whether or not the gas distributed by the Detroit City Gas Company is "merchantable," under the terms of the Company's franchise. The Professor is blind, more's the pity; but his olfactories are all right.

MR. IRVING E. BROWN, Superintendent of the Providence (R. I.) Burner Company, died at his home in Providence the afternoon of January 25th. He was in his 42d year.

AT the annual meeting of the Shenandoah (Pa.) allied lighting industries, the officers chosen were: President and General Manager, S. Kistler; Treasurer, P. J. Gaughan; Secretary, R. M. Dengler; Superintendent, William Cashner.

MR. MICHAEL F. BUCKLEY has been appointed Superintendent of the Penn Yan (N. Y.) Gas Company. Mr. Buckley was formerly in charge of the water works system of Penn Yan.

THE capital stock of the Marinette Gas Engine Company, of Chicago Heights, Ills., has been increased from $250,000 to $400,000.

IT is reported that the proprietors of the Fort Wayne (Ind.) Gas Company have under serious consideration the construction of an artificial gas plant, the supply of the natural article being, to say the least, not at all up to the requirements of the residents on fuel account.

NEWSPAPER advices are to the effect that articles incorporating the Palmyra (N. Y.) Gas Light Company have been filed with the authorities. The Company is to be capitalized in $50,000, it is to have a franchise life of 50 years, its purpose is to manufacture and supply gas and electricity for light, heat and power, its main place of business is Palmyra and its Directors are: Charles McLouth, C. C. M. Hunt, C. A. Schwarm, George H. Shepard and William T. Morris.

AT the annual meeting of the Ironton (O.) Gas Company the Directors elected were: Jere Davidson, Jno. P. McDonough, James Hudson, F. P. Herschel and M. Anderson.

MR. I. M. FELLHEIMER has resigned from the Directorate of the Macomb (Ills.) Gas and Electric Light Company. His interest in the concern was purchased by Mr. Albert Eads.

MR. E. C. SWAIN, for some time connected with the South Shore Gas and Electric Company, of Hammond, Ind., has accepted a responsible position with the Wilkes-Barre, Pa., Company. His successor at Hammond is Mr. L. J. Davis, of Ottumwa, Ia.

THE proprietors of the Beloit (Wis.) Gas Light and Coke Company have purchased the local plot known as the Holloway property, which

adjoins the Company's present site. It will come in useful some day as a good spot whereon to erect a gasholder.

MR. ARTHUR N. CANTRIL has resigned from the service of the Denver (Col.) Gas and Electric Company to accept the position of Manager of the New Business Department of the Grand Rapids (Mich.) Company.

IN the naming of officers in the Omaha (Neb.) Gas Company the following gentlemen were chosen: Directors, Frank B. Hamilton, George E. Barker, George H. Pritchett, Samuel T. Bodine and G. W. Clabaugh; President, Frank B. Hamilton—succeeding the late Frank Murphy; Vice-President and Secretary, George W. Clabaugh; Treasurer, Isaac Battin; Assistant Treasurer, Lewis Lillie; Assistant Secretary, Jas. Ball; Superintendent, George H. Waring.

A CORRESPONDENT in Milwaukee, Wis., writing under date of the 28th inst., says: "Mr. Stephen Aldridge, who has just completed his 48th year of service for the Milwaukee Gas Light Company, has been retired on full pay. He began his work for the Company in 1857. During the civil war he was a meter reader, and in 1870 he was taken into the office, where he remained as bookkeeper and teller until 1893. Since then he has been a collector. He is now 75 years old. Several months ago he was injured through a fall from a street car, and was incapacitated for work for a time. On the suggestion of Secretary Haase the action to retire Mr. Aldridge at full pay was taken, as expressed in the following excerpt from a letter from the Vice-President and General Manager of the Company, Col. E. G. Pratt: 'It is my pleasant duty to inform you that the Board of Directors has unanimously voted, in consideration for your long and faithful service, to place you upon the retired list at full pay. The only regret I have in this connection is that your age and disability seem to require it. I want you to feel that you are perfectly at home about the office or in any of the works or buildings of the Company.' Mr. Aldridge recently wrote a picturesque history of the Milwaukee Gas Light Company for Secretary Haase."

THE shareholders in the Morris (Ills.) Gas and Fuel Company have sanctioned a decrease in the Board of Directors, from 7 to 5.

IT does not seem that the petition of Mr. J. B. McKenzie and others, for the right to supply gas in Richmond, Cal., will be allowed.

THE plant and franchises of the artificial gas plant at Wapakoneta have been purchased or bought in by Mr. P. B. Chase, of Washington, D. C., acting for the bondholders.

THE electrical gentlemen, who some time ago secured control of the affairs of the Association that formerly represented the gas interests of Texas, are frantically endeavoring to keep the electric end of their responsibility going, so they have arranged a meeting to be held in Denison, Tex., May 11th to 13th. Mr. J. F. Strickland, of Dallas, is President of the Association.

AT a recent meeting of the Trustees of the borough of Litchfield, Conn., it was voted "not to construct, purchase, lease or maintain plants for the manufacture and distribution of gas or electricity."

ON December 31st last, according to the annual report of the Superintendent of Public Lighting (Mr. Henry Hopkins) New Haven, Conn., had 1,935 lamps in service on public account, thus divided: Electric arcs, 565; police signal (gas), 37; Welsbach, ordinary gas, 1,192; Welsbach, naphtha, 141. The Inspector in his report also declares that all the contractors on public account kept well abreast of the governing specifications, which would seem well borne out from the fact that all deductions on account of "outages," etc., amounted in value to $214.08.

THE residents of the outlying districts of Cheshire and Clarksburg are anxious that the Adams (Mass.) Gas Light Company shall extend its service to their territory.

A CORRESPONDENT in Mancester, N. H., writing under date of the 24th ult., incloses the following: "At the annual meeting of the shareholders in the Brattleboro (Vt.) Gas Light Company the officers elected were: Directors, H. D. Hilton, George C. Averill, James L. Martin, Chas. H. Thompson and Robert Gordon; Clerk and Treasurer, Charles F. Thompson. According to the Treasurer's report, it seems the Company enjoyed a prosperous year, in both its gas and electrical divisions, but anyone who attempts to analyze the reports cannot avoid the conclusion that the gas end of the game was easily first, since extraordinary expenses on acsount of the electric division absorbed some $7,000 or $8,000 of the earnings. Something happened to the West river dam that caused the reconstruction of plant necessary to secure power for moving the electrical currents, etc."

THE Lawrence (Mass.) Gas Light Company has declared its regular interim dividend of $3 per share. It is payable on demand, since the 1st inst.

THE Consolidated Gas Company, of New York, has declared a quarterly dividend of 2½ per cent., payable March 15th.

AT the annual meeting of the Portland (Me.) Gas Light Company, everything was serene. Superintendent Yorke's annual report showed that the output for the twelve months indicated an increase amounting to 8½ per cent., that several thousand dollars had been expended judiciously on betterment account, that the gain in separate consumers' meters was 403, and that 971 gas ranges, water heaters, etc., had been installed. He also reported the placing of 384 lamps of the gas arc type. The officers chosen were: Directors, E. H. Daveis, W. J. Moulton, Elias Thomas, F. N. Dow, Charles S. Forbes, and Arthur I. Hamilton. President, Edward H. Daveis, Vice-President, William H. Moulton; Treasurer, Benton Smart; Engineer, Eugene H. Yorke.

A CORRESPONDENT in Hull, England, writing under date of the 20th ult., respecting coal exports from that country, says: During the fiscal year 1903-4 the exports of coal, etc., were just upon 47,000,000 tons, and the bunker coal only a little short of 17,000,000 tons. This is the largest output upon record, and it is reasonable to assume from it that the coal tax has not materially affected the volume of coal exports. The continuous upward movement of these exports is very remarkable. If the last 50 years are taken, it will be found that four out of every five show an increase on the preceding year, and every quinquennial average of the half century shows an increase on its predecessor. With the exception of 1877 the decline was never over 5 per cent., and in that year it was very little more—14,881,000 tons as against 15,690,000 tons in 1876. Often in the face of circumstances that must have exercised a very prejudicial effect—as for example last year, which was a very bad one from the shipping point of view—the growth has gone on. Financial panics, famine prices, commercial depression, all have had to be reckoned with, but they have been hardly traceable in the total figures. Labor disputes seem to have been more accountable for the heavier decreases, than anything else. In 1877, when the decrease amounted to a little over 5 per cent., there were numerous labor troubles, which, coupled with the falling off in the Baltic demand, explains the shrinkage of the year. The effect of labor troubles are clearly traceable in the particular groups of shipping ports more immediately concerned, but the enormous expansion in the use of steam, more especially for navigation purposes, has usually more than made up in the grand total of exports for the deficiency of particular districts. With an export last year of close upon 64,000,000 tons, the opinion expressed by the Coal Commission of 1866 reads strangely. In this report, issued in 1871, the Commissioners stated that "As regards the future exportation of coal, although a very large increase has taken place within the period embraced by the preceding table (1855-1869), yet there is reason to doubt whether much further increase will take place in this direction." The export given in the table for 1869 was 10,245,000 tons, and if we add 2,100,000 for bunkers, the total is 12,345,000, as against the 64,000,000 of last year? And yet the majority of the Commissioners were men of acknowledged ability and great scientific attainments. The reduction in freights consequent upon the substitution of steam for sail has had much to do with the growth of our coal exports. Mr. D. A. Thomas, M.P., gives some very striking figures under this head. He shows that outward coal freights, in what may be called ordinary times, are now not half what they were 30 years ago. 1901 represented a normal condition of things, and if the freights ruling in that year are compared with those of 1872, it will be found that the average coal freight from Cardiff to 18 principal ports in the French and Mediterranean group was 14s. 1d. in 1872 and 6s. 4d. in 1901, a fall of over 55 per cent., while the general average of the freights to 40 ports in different parts of the world fell from 20s. 2d. in 1872 to 9s. 10d. in 1901. Broadly, normal coal freights are less than half what they were a generation ago. In 1902 the average freight (5s. 4d.) from Cardiff to Port Said (3,072 miles) was below the cost of carrying coal by rail from South Wales (say the center of the Rhondda Valley) to London (170 miles), Liverpool (175 miles), or Southampton (128 miles.)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

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CHAS. E. SANDERSON,
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MONDAY, FEBRUARY 6, 1905.

The Market for Gas Securities.

The market for Consolidated gas during the week was as it has been for the past month—dull, strong and well held. The closing prices to-day (Friday) were 203½ to 204, which figures include the regular quarterly payments on dividend account of 2½ per cent. The legislators, both State and city, are pretty well mixed up over their investigation proceedings, and about the greatest flounderer in the mortar of the several troughs is Comptroller Grout. This time it looks that his feet will stick; not his shoes. Mr. Gawtry has declined a re-election as President of the Consolidated, his health condition being such that active business cares will not serve its mending. He did much good work in his time for the gas trade of New York city. His successor has not been named.

Brooklyn Union is at nominal figures—205 to 210. We understand that Chief Engineer Jordan of the Company's western division, has planned an extensive scheme of plant enlargement. Baltimore Consolidated is 85, bid; Peoples, of Chicago, is 107½ to 107¾: Laclede preferred is 95 to 100, and Washington (D. C.) is 319½ to 320. Cincinnati is 107¼ to 108, and President Kenan and his associates say, and with reason, that it is worth 130. The general market is strong.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

FEBRUARY 6.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	203¼	204
Central Union, Bonds, 5's	3,000,000	1,000	108½	110
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Mutual	3,500,000	100	300	320
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	112	113½
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	35	
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..		
Northern Union, Bonds, 5's.	1,250,000	1,000	104	106
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106½	108½
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	205	210
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	—	—
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	5¼
" " Bonds, 5's	5,250,000	1,000	66	68½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	29,500,000	100	107¾	108
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	97½	99
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89½
Preferred	3,026,500	100	107½	109
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	85	..
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
" Con. Mtg. 5's	980,000	1,000	89½	92
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	75	75¼
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	85	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	104½	105½
" Bonds, 5's	10,500,000	..	107	108
Indianapolis	2,000,000	..	70	75
" Bonds, 6's	2,650,000	..	106½	108
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	..
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	136	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	218¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	107½	107¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	15,800,000	100	58½	58¾
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	94	96

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Stacey Mfg. Co., Cincinnati, O. 235
The P. H. & F. M. Roots Co., Connersville, Ind. 223
The Western Gas Construction Co., Fort Wayne, Ind. 240

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A man having 13 years' experience in all lines of the gas business wishes to obtain the management of a plant operating in a place of 10,000 or 15,000 inhabitants. Prefer a position needing energetic effort to secure results. Am not afraid of work. Can give references from former employers. Address, "P. R.,"
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Engagement desired by a man of 38, as superintendent of a gas company. Thoroughly familiar with entire management of the business. Experienced in coal and water gas. Can show good results as to economical manufacturing and increasing consumption. Can give good reasons for desiring to make a change.
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In a Southern town. Have had 18 years' experience building and operating coal and water gas plants. Am also familiar with commercial end of business. Satisfactory reasons for being out of business will be given to inquiring party.
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In a Western city of 25,000 inhabitants. Must be competent and reliable. Salary to the right man, $1,800 per year. Address, with references.
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By a gas gas and electric company in a city of 175,000 population.
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WANTED,

EXPERIENCED GAS MAKER,

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1548-3 LAWRENCE, KAS.

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STEAM TURBINES.

De Laval Steam Turbine Co., Trenton, N. J..... 216

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NO EXTRA LABOR OR OPERATING EXPENSES.

IMPROVED AMMONIA CONCENTRATOR.

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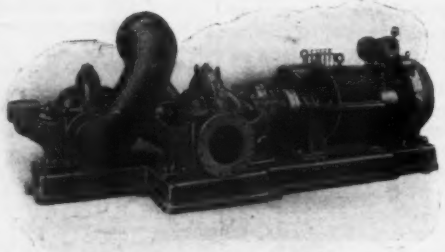

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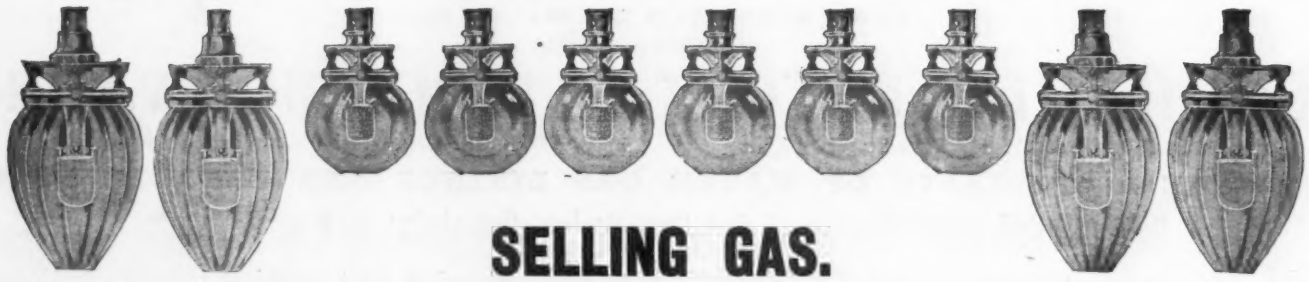

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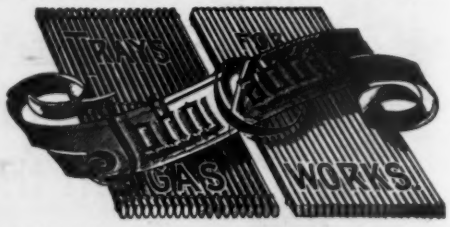

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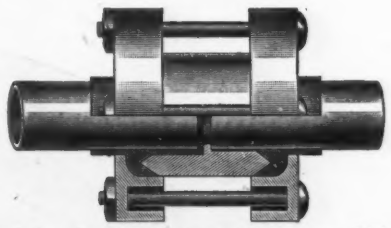

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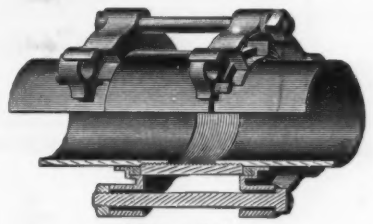

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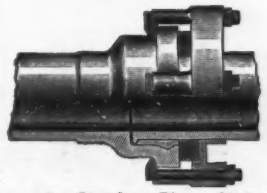

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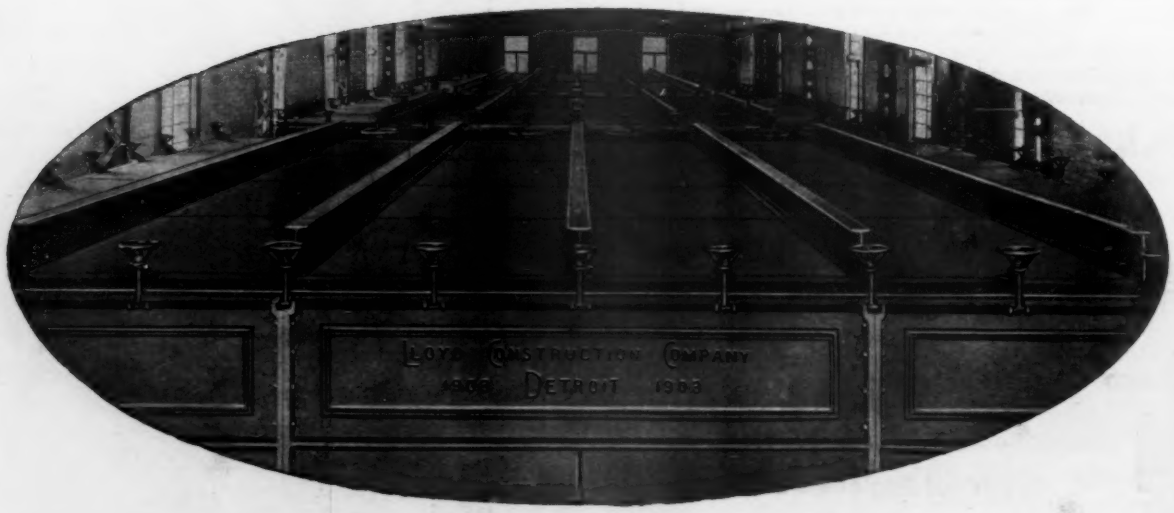

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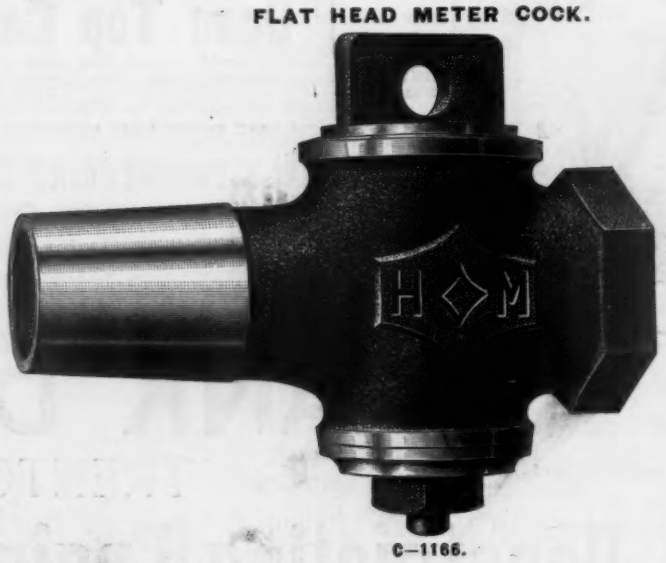

C—1166.

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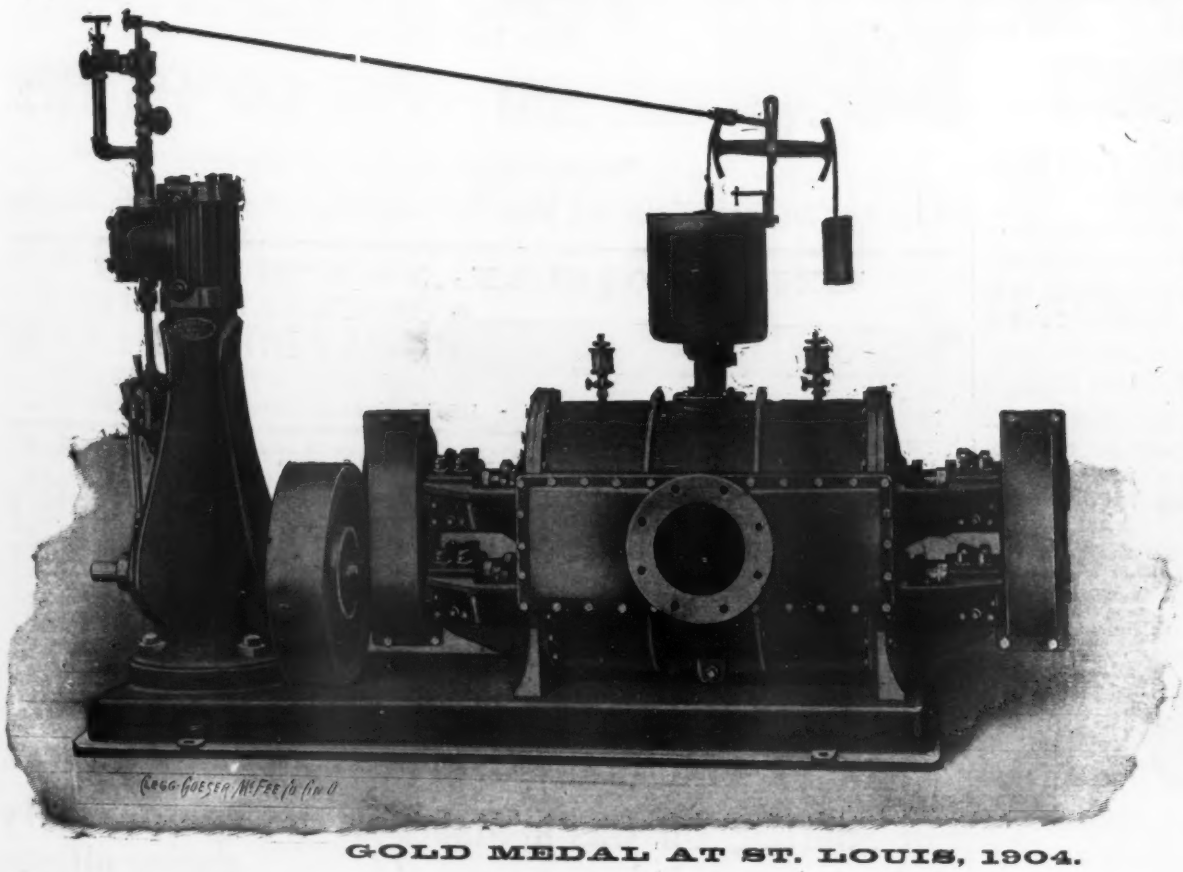

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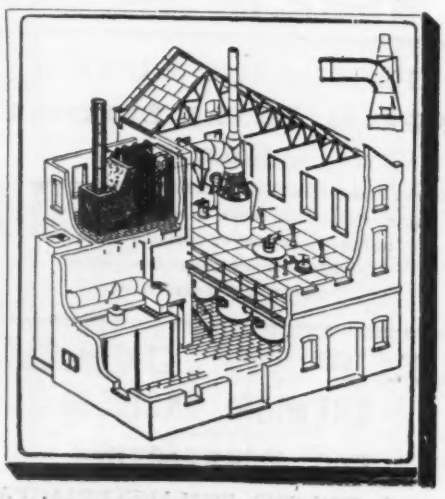

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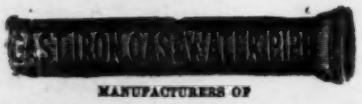

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GAS TAPPING MACHINES

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WITHOUT ANY ESCAPE OF GAS.

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Machines Sent to any Gas Company for Thirty Days' Trial.

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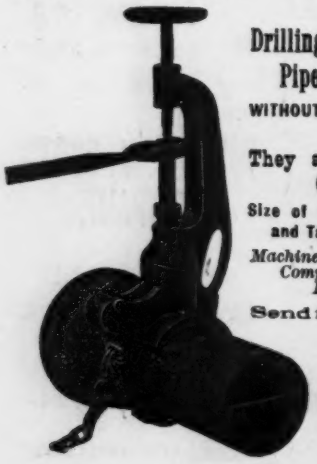

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FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

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For Shutting Off Gas in Mains Temporarily during alterations and repairs. : : : :

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AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

FEBRUARY, 1905.

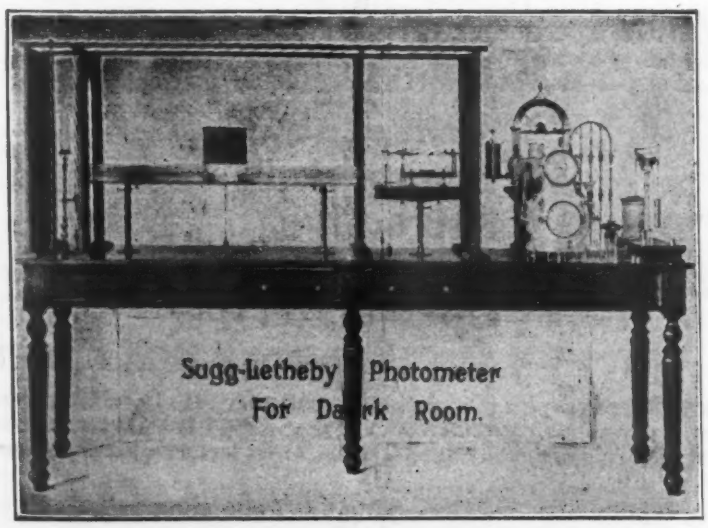
Table No. 1.
FOLLOWING THE MOON.

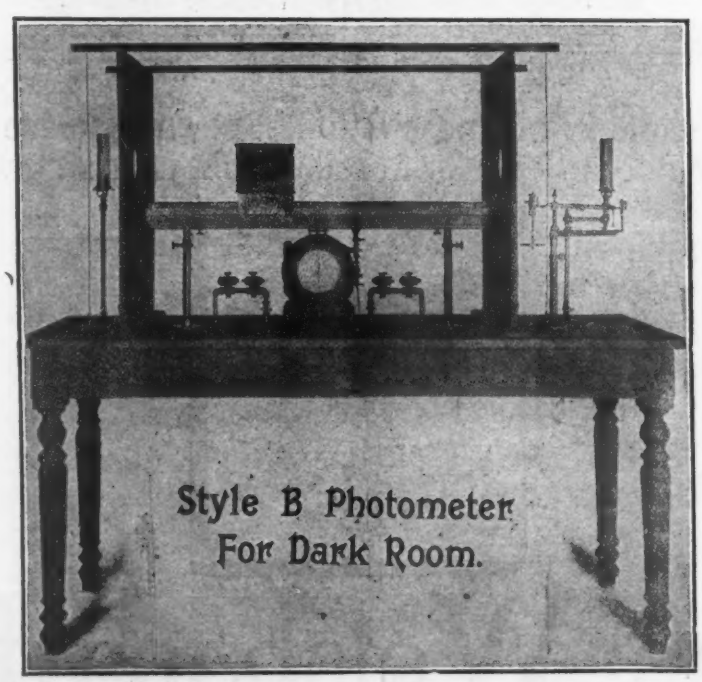
Day of Week.	Date.	Light.	Extinguish.
Wed.	1	5.50 PM	6.10 AM
Thu.	2	5.50	6.10
Fri.	3	5.50 NM	6.10
Sat.	4	5.50	6.10
Sun.	5	5.50	6.00
Mon.	6	5.50	6.00
Tue.	7	5.50	6.00
Wed.	8	8.30	6.00
Thu.	9	9.30	6.00
Fri.	10	10.30	6.00
Sat.	11	11.20	6.00
Sun.	12	12.20 AM FQ	5.50
Mon.	13	1.20	5.50
Tue.	14	2.10	5.50
Wed.	15	3.10	5.50
Thu.	16	4.00	5.50
Fri.	17	4.50	5.50
Sat.	18	No L.	No L.
Sun.	19	No L. FM	No L.
Mon.	20	No L.	No L.
Tue.	21	6.10 PM	9.10 PM
Wed.	22	6.10	10.30
Thu.	23	6.10	11.40
Fri.	24	6.10	12.40 AM
Sat.	25	6.10 LQ	1.50
Sun.	26	6.20	2.50
Mon.	27	6.20	3.40
Tue.	28	6.20	4.40

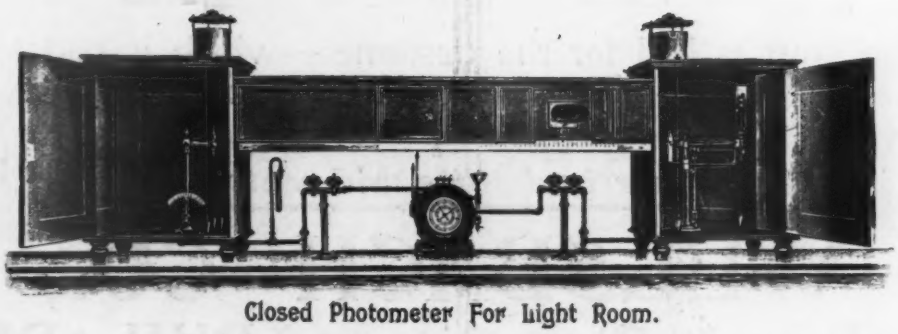
TOTAL HOURS DURING 1905.

By Table No. 1.

	Hrs.Min.
January	240.50
February	192.20
March	207.00
April	175.10
May	161.00
June	139.50
July	149.00
August	161.50
September	173.00
October	205.00
November	211.00
December	229.00
Total, yr.	2245.00







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

FEBRUARY, 1905.

Table No. 2.
NEW YORK CITY.
All Night Lighting.

Day of Week.	Date.	Light.	Extinguish.
		A.M.	P.M.
Wed.	1	5.05	6.15
Thu.	2	5.05	6.15
Fri.	3	5.05	6.15
Sat.	4	5.05	6.15
Sun.	5	5.10	6.10
Mon.	6	5.10	6.10
Tue.	7	5.10	6.10
Wed.	8	5.10	6.10
Thu.	9	5.10	6.10
Fri.	10	5.10	6.10
Sat.	11	5.10	6.10
Sun.	12	5.20	5.55
Mon.	13	5.20	5.55
Tue.	14	5.20	5.55
Wed.	15	5 20	5.55
Thu.	16	5.20	5.55
Fri.	17	5.20	5.55
Sat.	18	5.20	5 55
Sun.	19	5.30	5.55
Mon.	20	5.30	5.55
Tue.	21	5.30	5.55
Wed.	22	5.30	5.55
Thu.	23	5.30	5.55
Fri.	24	5.30	5.55
Sat.	25	5 30	5.55
Sun.	26	5.30	5.45
Mon.	27	5.30	5.45
Tue.	28	5.30	5.45

TOTAL HOURS DURING 1905.

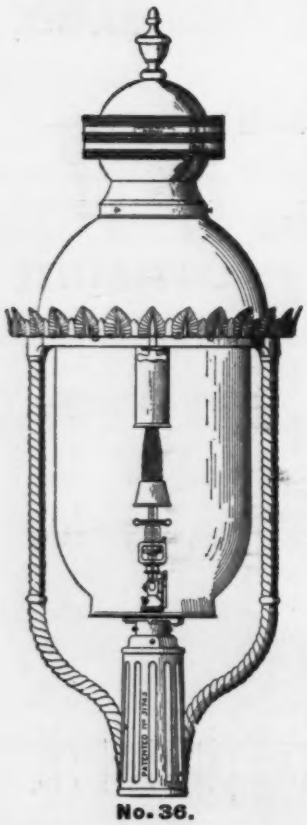
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 97 Liberty Street. BOSTON, 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

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IT LIGHTS THE STREET.

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IT IS A GUARANTEE AND A PROTECTION.

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Augusta, Me.
Bangor, Pa.
Woonsocket, R. I. (2d contract).
Brooklyn, N. Y. (4th contract).
Cincinnati, O. (2d contract).
Scranton, Pa. (3d contract).
New York City (14th contract).
New Haven, Conn. (2d contract).
Watertown, N. Y.
Tampa, Fla. (3d contract).
Westchester, N. Y. (3d contract).
Bridgeport, Conn. (2d contract.)
St. Paul, Minn. (2d contract).
Springfield, Mass. (2d contract).
Lynn, Mass. (5th contract).
Rochester, N. Y.
Battle Creek, Mich.
Mechanicsburg, Pa.
Excelsior Springs, Mo.
Bristol, Conn.
Jersey Shore, Pa.
Vicksburg, Miss.

TOTAL SETS, 1904, ... 45
TOTAL DAILY CAPACITY, 1904, ... 56,325,000 cubic feet.
TOTAL SETS TO DATE, ... 553
TOTAL DAILY CAPACITY, ... 419,180,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
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H. D. ABERNETHY, Sec.

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Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

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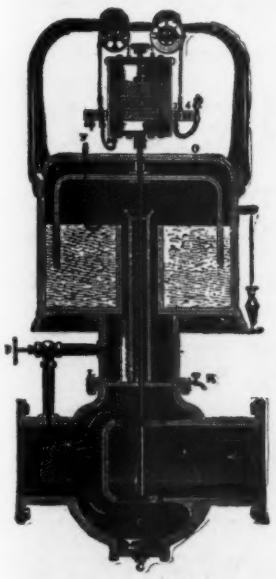

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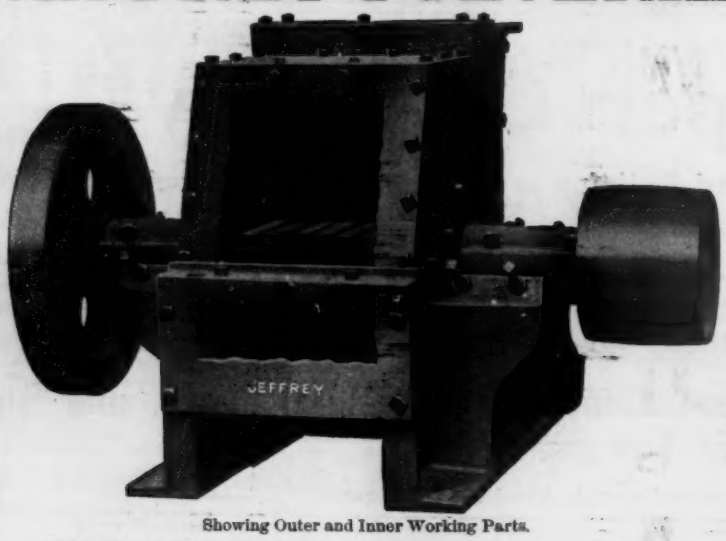

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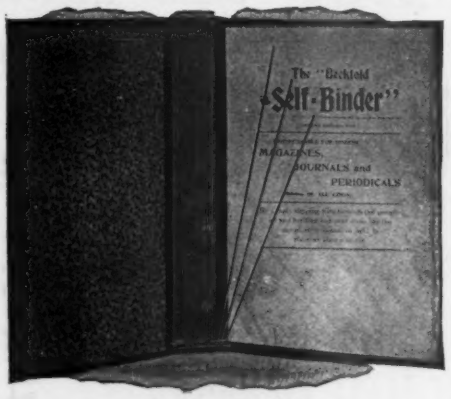

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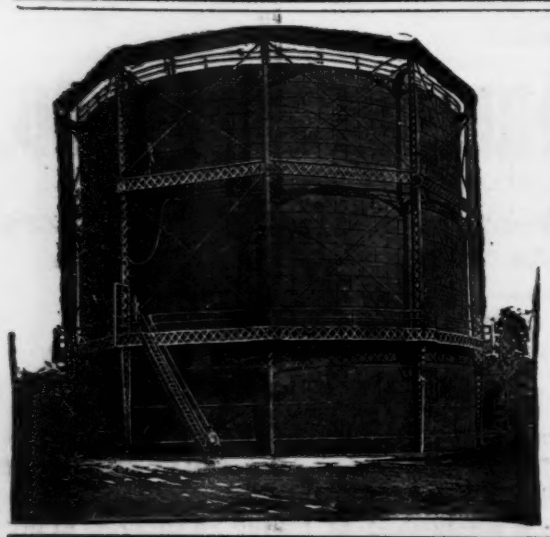

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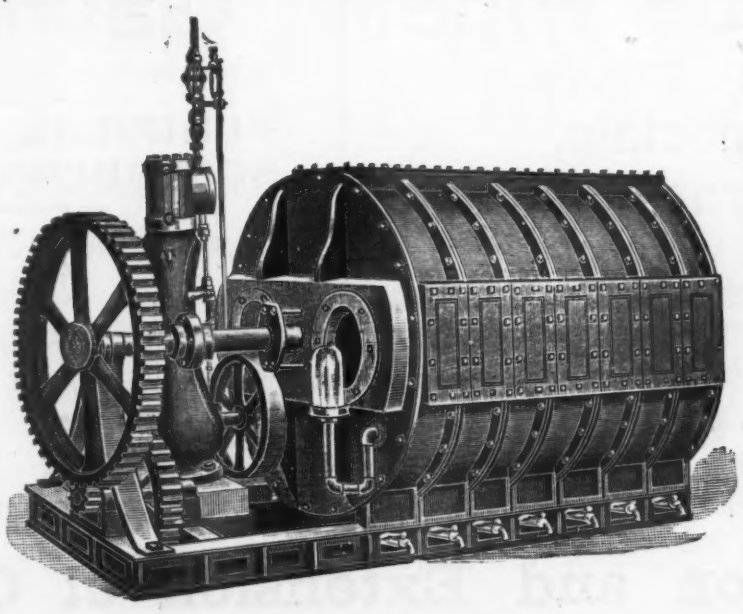

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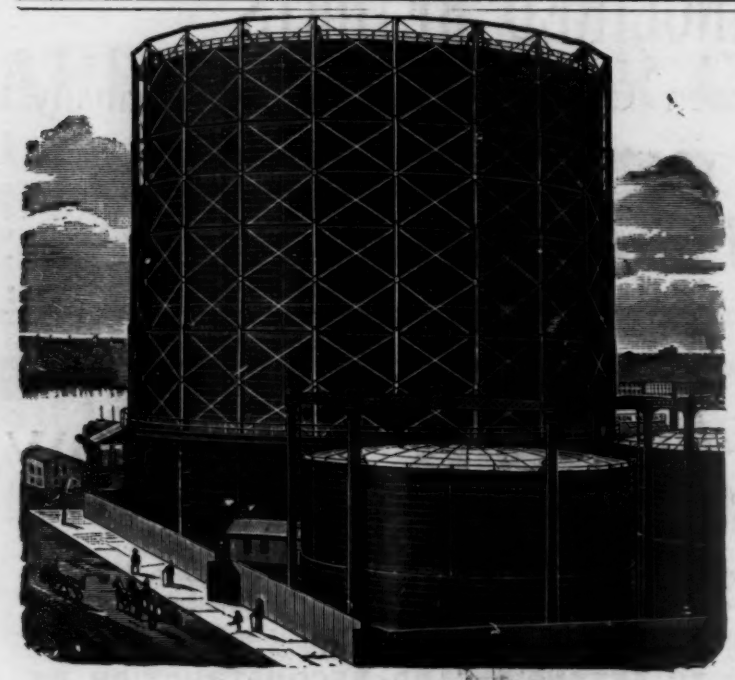

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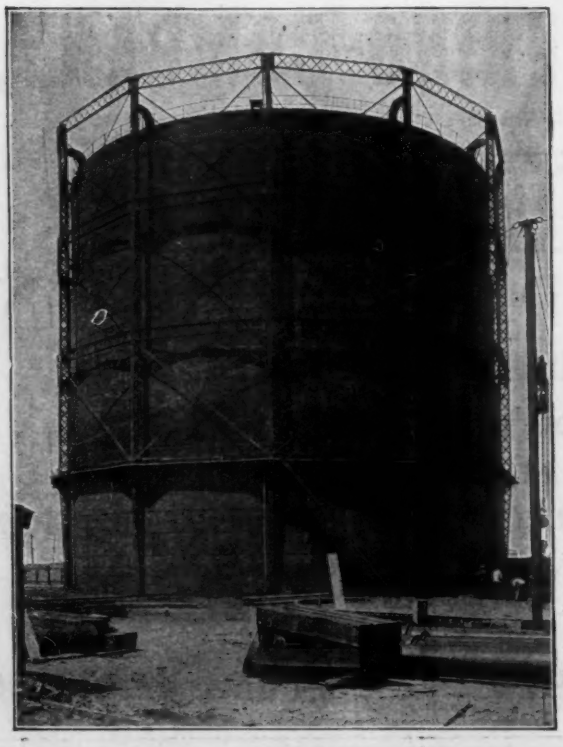

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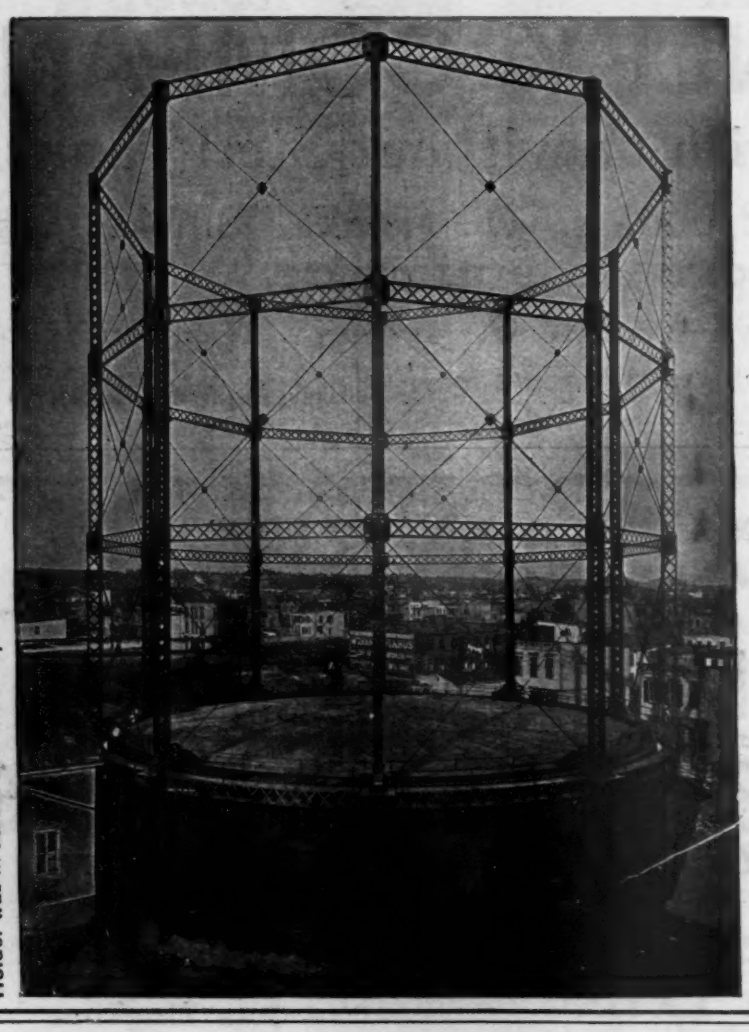

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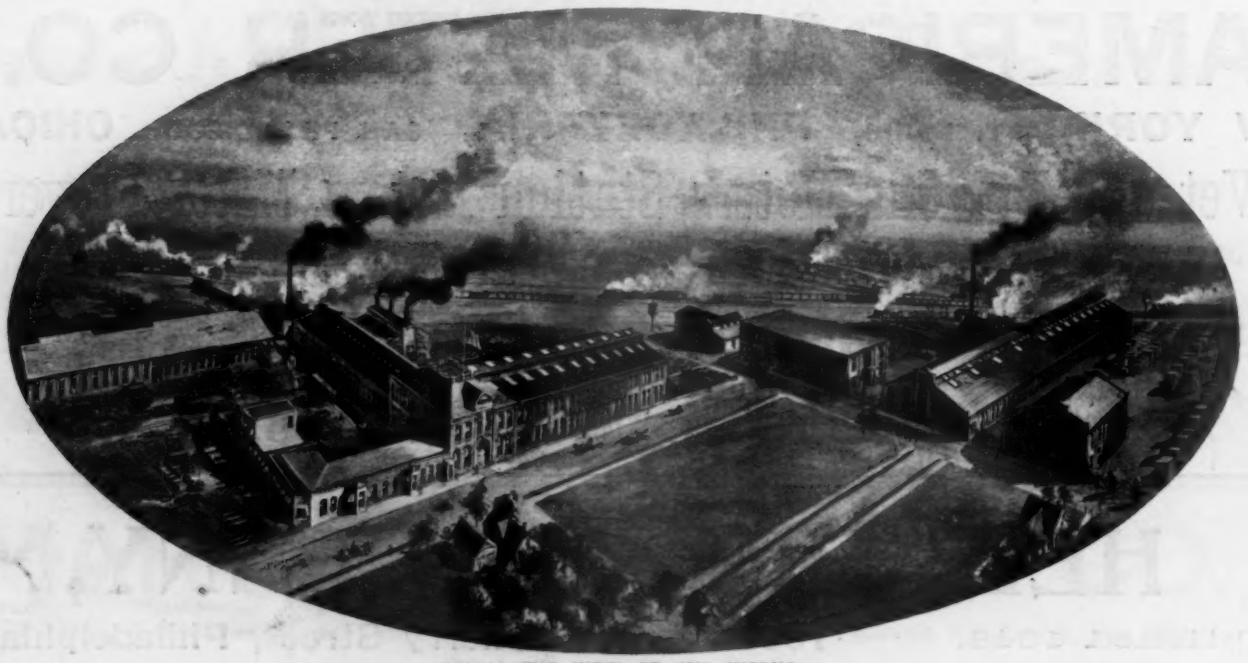

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